

[Volume I, Appx00001 – Appx00309]

Nos. 22-1972, -1973, -1975, -1976

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IN THE  
**United States Court of Appeals**  
FOR THE FEDERAL CIRCUIT

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MASIMO CORPORATION,

*Appellant,*

v.

APPLE INC.,

*Appellee.*

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APPEAL FROM THE PATENT TRIAL AND APPEAL BOARD  
CASE NOS. IPR2020-01713, IPR2020-01716, IPR2020-01733, IPR2020-01737

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**JOINT APPENDIX**

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May 10, 2023

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	Ex. 1010	“A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring” Mendelson-2006 [IPR2020-01713]	Appx02548-02551
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	Ex. 2006	Deposition Transcript of Dr. Thomas W. Kenny in IPR2020-01520, IPR2020-01537, IPR2020-01539 (April 22, 2021) [IPR2020-01713]	Appx05383; Appx05465-05466; Appx05468-05469; Appx05479; Appx05482-05483; Appx05514-05516;

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	Ex. 1003	Declaration of Dr. Thomas W. Kenny [IPR2020-01737]	Appx21940; Appx21974-21992, Appx21998-22003
	Ex. 1060	Second Declaration of Dr. Thomas W. Kenny [IPR2020-01737]	Appx23524; Appx23528-23562
	Ex. 2004	Declaration of Dr. Vijay K. Madisetti [IPR2020-01737]	Appx24625; Appx24659-24663;

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Paper 31  
Entered: May 2, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC.,  
Petitioner,

v.

MASIMO CORPORATION,  
Patent Owner.

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Patent 10,624,564 B1

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Before JOSIAH C. COCKS, ROBERT L. KINDER, and  
AMANDA F. WIEKER, *Administrative Patent Judges*.

KINDER, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
*35 U.S.C. § 318(a)*



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Patent 10,624,564 B1

## I. INTRODUCTION

### *A. Background*

Apple Inc. (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–30 (“challenged claims”) of U.S. Patent No. 10,624,564 B1 (Ex. 1001, “the ’564 patent”). Paper 2 (“Pet.”). Masimo Corporation (“Patent Owner”) waived filing a Preliminary Response. Paper 6. We instituted an *inter partes* review of all challenged claims 1–30 on all asserted grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 7 (“Inst. Dec.”).

After institution, Patent Owner filed a Response (Paper 14, “PO Resp.”) to the Petition, Petitioner filed a Reply (Paper 18, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 21, “Sur-reply”). An oral hearing was held on February 9, 2022, and a transcript of the hearing is included in the record. Paper 30 (“Tr.”).

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–30 of the ’564 patent are unpatentable.

### *B. Related Proceedings*

*Masimo Corporation v. Apple Inc.*, Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

*Apple Inc. v. Masimo Corporation*, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

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*Apple Inc. v. Masimo Corporation*, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims 1–29 of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01716 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1); and

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*Apple Inc. v. Masimo Corporation*, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1).

Pet. 3; Paper 3, 1, 3–4.

Patent Owner further identifies certain pending patent applications, as well as other issued and abandoned applications, that claim priority to, or share a priority claim with, the '564 patent. Paper 3, 1–2.

### *C. The '564 Patent*

The '564 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on April 21, 2020, from U.S. Patent Application No. 16/725,292, filed December 23, 2019. Ex. 1001, codes (21), (22), (45), (54). The '564 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/086,060, 61/086,108, 61/086,063, and 61/086,057, each filed on August 4, 2008, as well as 61/091,732, filed on August 25, 2008, and 61/078,228 and 61/078,207, both filed on July 3, 2008. *Id.* at codes (60), (63).

The '564 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:47–51. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:38–46, 3:4–6. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:54–57.

The diagram illustrates a system 100 for measuring tissue properties. The system is divided into two main sections: a SENSOR 101 and a MONITOR 109.

**SENSOR 101:** This section includes an EMITTER 104, a DRIVER 111, an OPTIONAL TISSUE SHAPER 105, an OPTIONAL NOISE SHIELD 106, and DETECTORS 107. The EMITTER 104 is connected to the DRIVER 111. The DRIVER 111 is connected to the EMITTER 104. The EMITTER 104 is connected to the OPTIONAL TISSUE SHAPER 105. The OPTIONAL TISSUE SHAPER 105 is connected to the OPTIONAL NOISE SHIELD 106. The OPTIONAL NOISE SHIELD 106 is connected to the DETECTORS 107. The DETECTORS 107 are connected to the FRONT-END INTERFACE 108.

**MONITOR 109:** This section includes a FRONT-END INTERFACE 108, a SIGNAL PROCESSOR 110, a USER INTERFACE 112, STORAGE 114, and a NETWORK INTERFACE 116. The FRONT-END INTERFACE 108 is connected to the SIGNAL PROCESSOR 110. The SIGNAL PROCESSOR 110 is connected to the USER INTERFACE 112. The USER INTERFACE 112 is connected to the STORAGE 114. The STORAGE 114 is connected to the NETWORK INTERFACE 116.

**Other Components:** A MEMORY 113 is connected to the FRONT-END INTERFACE 108 and the SIGNAL PROCESSOR 110. The FRONT-END INTERFACE 108 is also connected to the DRIVER 111.

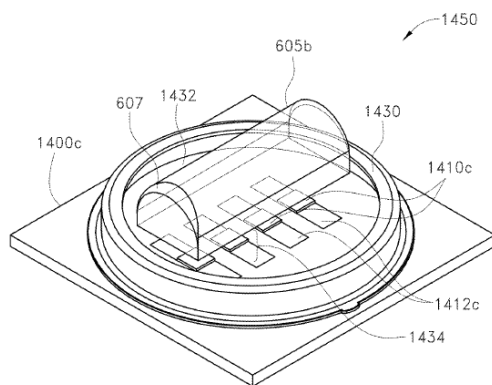
**FIG. 1**

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:27–29. “[S]ignal processor 110 includes processing logic that

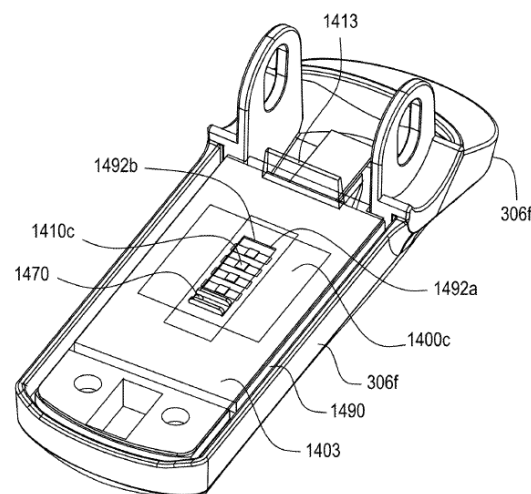
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determines measurements for desired analytes . . . based on the signals received from the detectors 106.” *Id.* at 15:32–35. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:57–61. In response to user input or device orientation, user interface 112 can “reorient its display indicia.” *Id.* at 15:63–67. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 16:4–22. In some embodiments, the monitor, including the display, is attached to the patient by a strap. *Id.* at 17:56–59, 18:16–19.

The ’564 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate sensor devices.



**FIG. 14D**



**FIG. 14F**

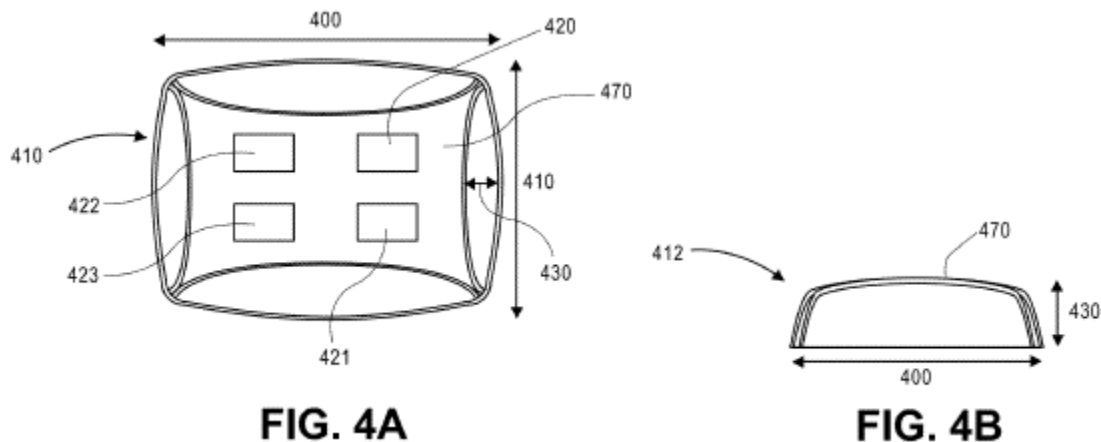
Figure 14D illustrates a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:54–57. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b is disposed. *Id.* at 36:40–47. Figure 14F illustrates detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:20–21. In some embodiments, the detector shell includes walls to separate individual photodiode arrays and to “prevent or

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reduce mixing of light signals.” *Id.* at 22:46–53. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* at 22:20–36.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.



Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement site contact area 470. *Id.* at 23:30–36. “[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site.” *Id.* “For example, the measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site.” *Id.* at 23:53–55. The measurement site contact area includes windows 420–423 that “mimic or approximately mimic a configuration of, or even house, a plurality of detectors.” *Id.* at 23:61–24:8.

#### *D. Illustrative Claim*

Of the challenged claims, claim 1 is independent. Claim 1 is illustrative and is reproduced below.

1. [pre] A user-worn physiological measurement device comprising:

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[a] one or more emitters configured to emit light into tissue of a user;

[b] at least four detectors arranged on a substrate;

[c] a cover comprising a protruding convex surface, wherein the protruding convex surface extends over all of the at least four detectors arranged on the substrate, wherein at least a portion of the protruding convex surface is rigid;

[d] one or more processors configured to: receive one or more signals from at least one of the at least four detectors, the one or more signals responsive to at least a physiological parameter of the user; and process the one or more signals to determine measurements of the physiological parameter;

[e] a network interface configured to communicate with a mobile phone;

[f] a touch-screen display configured to provide a user interface,

[g] wherein: the user interface is configured to display indicia responsive to the measurements of the physiological parameter, and

[h] an orientation of the user interface is configurable responsive to a user input;

[i] a wall that surrounds at least the at least four detectors, wherein the wall operably connects to the substrate and the cover;

[j] a storage device configured to at least temporarily store at least the measurements of the physiological parameter; and

[k] a strap configured to position the physiological measurement device on the user.

Ex. 1001, 44:63–45:29 (bracketed lettering [pre]–[k] added).

### *E. Applied References*

Petitioner relies upon the following references:

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Sherman et al., U.S. Patent No. 4,941,236, filed July 6, 1989, issued July 17, 1990 (Ex. 1013, “Sherman”);

Ali et al., U.S. Patent No. 6,584,336 B1, filed March 1, 2000, issued June 24, 2003 (Ex. 1019, “Ali”);

Rantala et al., U.S. Patent No. 6,912,413 B2, filed September 12, 2003, issued June 28, 2005 (Ex. 1022, “Rantala”);

Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1009, “Ohsaki”);

Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, “Aizawa”); and

Goldsmith et al., U.S. Patent Application Publication No. 2007/0093786 A1, filed July 31, 2006, published April 26, 2007 (Ex. 1011, “Goldsmith”).

Pet. 10.

Petitioner also submits, *inter alia*, a Declaration of Dr. Thomas W. Kenny, Ph.D. (Ex. 1003) and a Second Declaration of Dr. Kenny (Ex. 1050). Patent Owner submits, *inter alia*, the Declaration of Dr. Vijay K. Madiseti (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madiseti, including from this proceeding and others. Exs. 1053–1056, 2006–2009, 2027.

#### *F. Asserted Grounds of Unpatentability*

We instituted an *inter partes* review based on the following grounds. Inst. Dec. 10–11, 42.

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–10, 13–30	103	Aizawa, Ohsaki, Goldsmith
11	103	Aizawa, Ohsaki, Goldsmith, Sherman



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Claim(s) Challenged	35 U.S.C. §	References/Basis
12	103	Aizawa, Ohsaki, Goldsmith, Rantala
1–10, 13–30	103	Aizawa, Ohsaki, Goldsmith, Ali
11	103	Aizawa, Ohsaki, Goldsmith, Ali, Sherman
12	103	Aizawa, Ohsaki, Goldsmith, Ali, Rantala

## II. DISCUSSION

### A. Claim Construction

For petitions filed on or after November 13, 2018, a claim “shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b).” 37 C.F.R. § 42.100(b) (2020). Accordingly, we construe the claims according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). Based on our analysis of Petitioner’s challenges presented, we find that one claim term requires express construction.

Petitioner raises the issue of the proper scope of the claim term “processor” from claim 1 to a person of ordinary skill in the art. Pet. 51. Petitioner submits “[t]he ’564 patent does not define ‘processor,’” but argues that a person of ordinary skill in the art would understand the term to mean “part of a computer system that operates on data,” consistent with the definition provided in Merriam-Webster’s Collegiate Dictionary.<sup>1</sup> *Id.*; Ex. 1012, 5.

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<sup>1</sup> Petitioner adds page numbers 1–6 to Exhibit 1012. We refer to the added page numbers when citing to Exhibit 1012 in this Decision.

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In our Institution Decision, we observed that the claim language provides an understanding of the functions of the claimed one or more processors, which are “configured to:” “receive one or more signals” and “process the one or more signals to determine measurements of the physiological parameter.” Inst. Dec. 11–12 (quoting Ex. 1001, 45:6–12). We noted that “[t]he Specification describes several distinct processors, but it also describes a ‘signal processor’ as the device used for processing signals.” *Id.* at 12; *see, e.g.*, Ex. 1001, 9:50–55, 14:36–42, 15:27–56, 33:36–47.

Patent Owner does not object to our initial claim construction, and submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 7.

Based on the final record, we maintain our initial interpretation of the term “processor” as meaning “part of a computer system that operates on data.” *See* Ex. 1012, 5. This definition is consistent with the general operation of the signal processor in the ’564 patent, where the signal processor is described to include “processing logic that determines measurements . . . based on the signals received from the detectors.” Ex. 1001, 15:31–35; 15:35–39 (“signal processor 110 can be implemented using one or more microprocessors or subprocessors . . . digital signal processors, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), combinations of the same”).

Based on our analysis of the issues in dispute, we conclude that no further claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

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*B. Principles of Law*

A claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness.<sup>2</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

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<sup>2</sup> The parties have not presented objective evidence of non-obviousness.

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We analyze the challenges presented in the Petition in accordance with the above-stated principles.

*C. Level of Ordinary Skill in the Art*

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having “a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information.” Pet. 8 (citing Ex. 1003 ¶¶ 21–22). “Additional education in a relevant field or industry experience may compensate for one of the other aspects of the . . . characteristics stated above.” *Id.*

Patent Owner makes several observations regarding Petitioner’s identified level of skill in the art but, “[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner’s asserted level of skill.” PO Resp. 7–8.

We adopt Petitioner’s assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

*D. Obviousness over the Combined Teachings of  
Aizawa, Ohsaki, and Goldsmith*

Petitioner contends that claims 1–10 and 13–30 of the ’564 patent would have been obvious over the combined teachings of Aizawa, Ohsaki, and Goldsmith. Pet. 10–91; *see also* Pet. Reply 7–37. Patent Owner disagrees. PO Resp. 9–51; *see also* Sur-reply 1–27.

Based on our review of the parties’ arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 1–10 and 13–30 are unpatentable.

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### 1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled “Pulse Wave Sensor and Pulse Rate Detector,” and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient’s artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

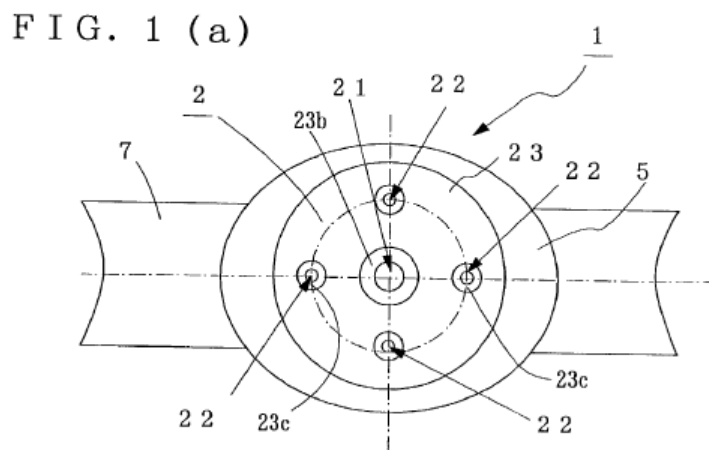


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode (“LED”) 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, “to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased.” *Id.* ¶ 32, Fig. 4(a). “The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22.” *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

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F I G . 1 ( b )

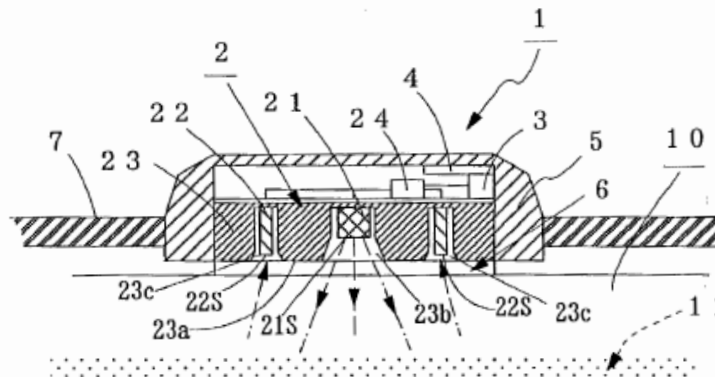


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an “unshown display.” *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.*

Aizawa discloses that LED 21 and photodetectors 22 “are stored in cavities 23b and 23c formed in the detection face 23a” of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a “is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a.” *Id.* Aizawa discloses that “a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side).” *Id.* ¶ 26. Furthermore, “the above belt 7 is fastened such that the acrylic

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transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.”

*Id.* ¶¶ 26, 34.

## 2. Overview of Ohsaki (Ex. 1009)

Ohsaki is a U.S. patent application publication titled “Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User’s Wrist,” and discloses “an optical sensor for detecting [a] pulse wave of a human body.” Ex. 1009, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

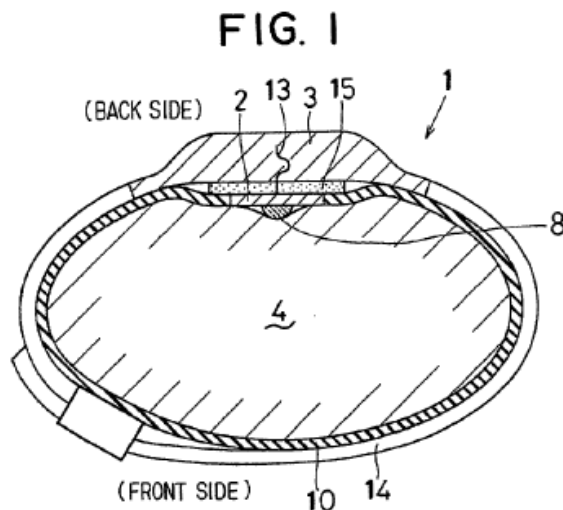


Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user’s wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

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Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

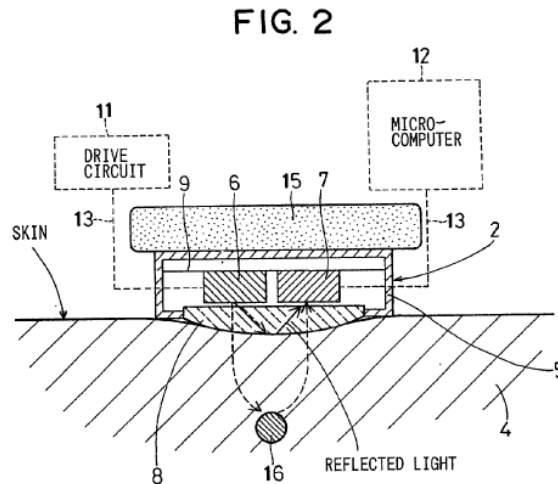


Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

“[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. “[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user’s skin,” preventing detecting element 2 from slipping off the detecting position of the user’s wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses “variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user’s skin.” *Id.* Additionally, the convex surface prevents penetration by “noise such as disturbance light from the outside.” *Id.*



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Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* “The monitor display shows the calculated pulse rate.” *Id.*

### 3. Overview of Goldsmith (Ex. 1011)

Goldsmith is a U.S. patent application publication titled “Watch Controller for a Medical Device,” and discloses a watch controller device that communicates with an infusion device to “provid[e] convenient monitoring and control of the infusion pump device.” Ex. 1011, codes (54), (57).

Goldsmith’s Figure 9A and 9B are reproduced below.

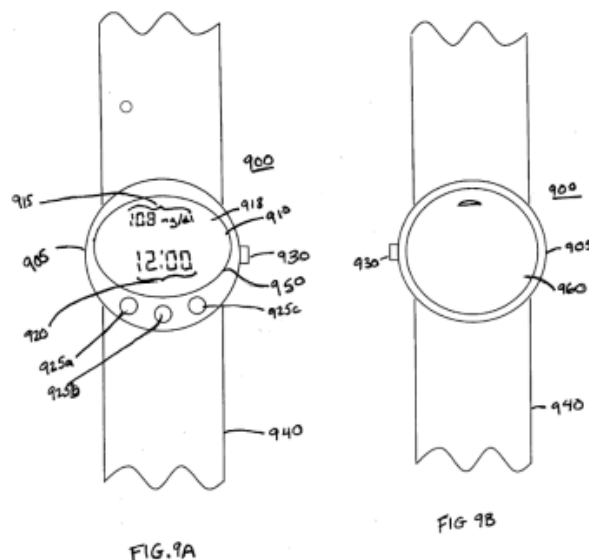


Figure 9A and Figure 9B are respective front and rear views of a combined watch and controller device. *Id.* ¶¶ 30–31. As shown in Figure 9A, watch

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controller 900 includes housing 905, transparent member 950, display 910, input devices 925a–c, scroll wheel 930, and wrist band 940. *Id.* ¶¶ 85–86. Figure 9B shows rear-side cover 960, and a rear view of housing 905, scroll wheel 930, and wrist band 940. *Id.*

Goldsmith discloses the watch controller may interact with one or more devices, such as infusion pumps or analyte monitors. *Id.* ¶ 85; *see also id.* ¶ 88 (“The analyte sensing device 1060 may be adapted to receive data from a sensor, such as a transcutaneous sensor.”). Display 910 “may display at least a portion of whatever information and/or graph is being displayed on the infusion device display or on the analyte monitor display,” such as, e.g., levels of glucose. *Id.* ¶ 86. The display is customizable in a variety of configurations including user-customizable backgrounds, languages, sounds, font (including font size), and wall papers. *Id.* ¶¶ 102, 104. Additionally, the watch controller may communicate with a remote station, e.g., a computer, to allow data downloading. *Id.* ¶ 89 (including wireless). The remote station may also include a cellular telephone to be “used as a conduit for remote monitoring and programming.” *Id.*

#### *4. Independent Claim 1*

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa, Ohsaki, and Goldsmith. Pet. 10–63. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties’ contentions and then provide our analysis.

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*i. “[pre] A user-worn physiological measurement device comprising”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa satisfies the subject matter of the preamble.<sup>3</sup> Pet. 41–42; *see, e.g.*, Ex. 1006 ¶ 26, code (57) (“a subject carries the above pulse rate detector 1 on the inner side of his/her wrist”), Fig. 2 (depicting a user wearing a pulse wave sensor on the inner side of his/her wrist); *see also* Ex. 1003 ¶ 98.<sup>4</sup>

*ii. “[a] one or more emitters configured to emit light into tissue of a user”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses an emitter, LED 21, that emits light into a user’s tissue. Pet. 42–43; *see, e.g.*, Ex. 1006 ¶ 23 (“LED 21 . . . for emitting light having a wavelength of a near infrared range”), ¶ 27 (explaining that light is emitted toward the wrist), Fig. 1(b) (depicting LED 21 facing user wrist 10), Fig. 2 (depicting a pulse wave sensor worn on a user’s wrist).

*iii. “[b] at least four detectors arranged on a substrate;”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses at least four detectors. Pet. 23–25, 44–46; *see, e.g.*,

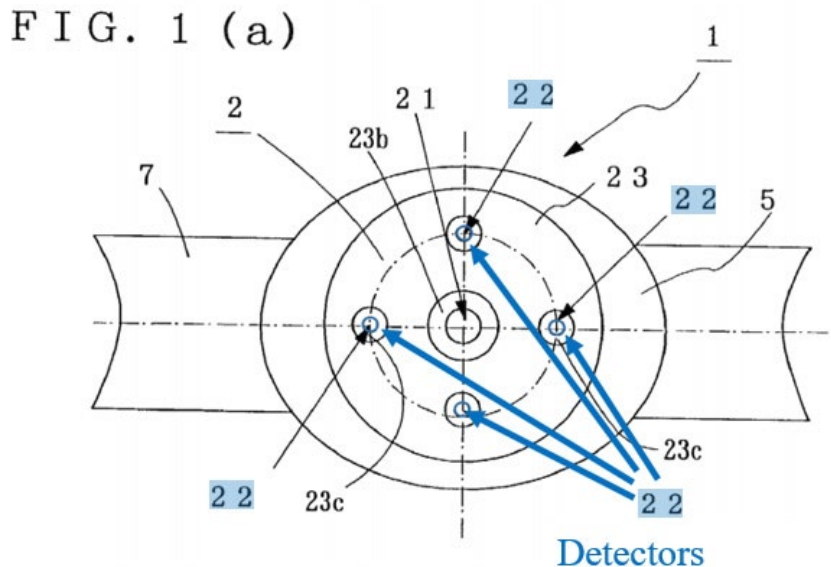
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<sup>3</sup> Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble’s subject matter is satisfied by the art.

<sup>4</sup> Petitioner further contends that the subject matter of the preamble is taught by the combination of Aizawa, Ohsaki, and Goldsmith. Pet. 41–42 (arguing that it would have been obvious to incorporate the pulse wave sensor of Aizawa (as modified by Ohsaki) into the wrist-worn watch controller device in Figures 9A and 9B of Goldsmith, to realize a user-worn physiological measurement device). Because Figure 2 of Aizawa teaches a user-worn physiological measurement device, further analysis of the combination of Aizawa, Ohsaki, and Goldsmith is not necessary for the preamble.

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Ex. 1006 ¶¶ 9, 23 (“four phototransistors 22”), Figs. 1(a)–1(b); Ex. 1003 ¶¶ 43–45, 64–67. Petitioner contends that pulse wave sensor depicted in Figure 1(a) of Aizawa, reproduced below, discloses four photodetectors 22. Pet. 44; *see, e.g.*, Ex. 1006 ¶ 27 (“[F]our photodetectors 22 are disposed around the light emitting diode 21.”).



Petitioner’s Annotated Figure 1(a) of Aizawa depicts four photodetectors 22, identified by blue arrows and blue shading.

Relying on a cross-section view of Figure 1(b) of the pulse wave detector of Aizawa, Petitioner further contends photodetectors 22 are secured on a substrate illustrated in Petitioner’s annotated Figure 1(b). Pet. 24, 45. Petitioner’s annotated Figure 1(b) of Aizawa is reproduced below.

The diagram shows a cross-section of a device with a central substrate (3) and a top layer (2). An LED (2 1) is mounted on the substrate. Two detectors (2 2) are positioned on either side of the LED. Light from the LED passes through the substrate and is detected by the detectors. The device is mounted on a base (1 0) with a first surface of the substrate (23a) and a second surface (23b). The light path is indicated by arrows, showing light entering the substrate (21S) and being detected by the detectors (22S). The light is attenuated by the tissue and detected by the detectors.

Petitioner further contends that if Aizawa is found not to disclose a substrate, then Ohsaki teaches this feature. Pet. 25. Similar to the device of Aizawa, Ohsaki teaches a pulse wave sensor comprising a light emitting

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element 6 (*e.g.*, a LED) and a light receiving element (*e.g.*, a photodetector). Ex. 1009 ¶ 17. “The light emitting element 6 and light receiving element 7 are . . . arranged on the circuit board 9.” *Id.* Relying on the testimony of Dr. Kenny, Petitioner contends a POSITA would have modified the pulse wave sensor of Aizawa to include a substrate, such as circuit board 9 of Ohsaki, to secure the photodetectors of Aizawa and enable the detectors to send signals to other elements in the device. Pet. 25 (citing Ex. 1003 ¶¶ 72–73; Ex. 1006 ¶¶ 2–5, 8–16, 23, 27–29, 32–33, Figs. 1, 2, 3, 4(a); Ex. 1009 ¶ 17, Fig. 2).

The cited evidence, including the unrebutted testimony of Dr. Kenny, sufficiently supports Petitioner’s stated reasoning.

*iv. “[c] a cover comprising a protruding convex surface, wherein the protruding convex surface extends over all of the at least four detectors arranged on the substrate, wherein at least a portion of the protruding convex surface is rigid”*

#### Petitioner’s Undisputed Contentions

Petitioner contends that Aizawa discloses a cover, *i.e.*, a “transparent plate positioned between the photodetectors and the wrist.” Pet. 12 (citing Ex. 1006 ¶ 34). Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that “acrylic transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to the wrist 10.” Ex. 1006 ¶ 34, Fig. 1(b) (depicting transparent plate 6 between sensor 2 and wrist 10).

Petitioner also contends that Ohsaki teaches a wrist-worn sensor that includes a “translucent board” having a convex surface that contacts the user’s skin. Pet. 15, 21. Patent Owner does not dispute this contention, and

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we agree with Petitioner. Ohsaki discloses that sensor 1 includes detecting element 2 and sensor body 3, and is “worn on the back side of the user’s wrist.” Ex. 1009 ¶ 16. Ohsaki discloses that detecting element 2 includes package 5 and “translucent board 8[,which] is a glass board which is transparent to light, and [is] attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. As seen in Ohsaki’s Figure 2, translucent board 8 has a single protruding convex surface, which is placed between a user’s tissue and a light receiving element (e.g., photodetector) 7 when the sensor is worn. *Id.* at Fig. 2. As also seen in Figure 2, the board 8 is operably connected to the walls of sensor package 5. *Id.* ¶ 17 (“The translucent board 8 is . . . attached to the opening of the package 5.”), Fig. 2.

Claim 1 further requires that “at least a portion of the protruding convex surface is rigid.” Petitioner contends that Ohsaki’s Figure 2 depicts the user’s tissue in intimate contact with the convex surface of the cover and the cover is sufficiently rigid to cause the skin to deform. Pet. 15, 48 (The “convex surface . . . causes the user’s skin to deform . . . due to the rigidity of the convex surface.”). Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki’s Figure 2 depicts the user’s tissue 4 deforming and conforming to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1009 ¶ 17 (“The translucent board 8 is a glass board.”), Fig. 2.

#### Petitioner’s Disputed Contentions

Petitioner further contends that a person of ordinary skill in the art “would have found it obvious to modify Aizawa’s sensor to include a cover having a protruding convex surface,” so as to [1] improve adhesion between

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the user's wrist and the sensor's surface, [2] improve detection efficiency, and [3] protect the elements within sensor housing. Pet. 20–23 (citing, e.g., Ex. 1003 ¶¶ 67–70; Ex. 1009 ¶ 25). Petitioner contends that Ohsaki's convex surface is in “intimate contact” with the user's skin, which prevents slippage of the sensor and increases signal strength because “variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed” and because “the pulse wave can be detected without being affected by the movement of the user's wrist 4,” as compared to a sensor with a flat surface. *Id.* at 21–22 (citing, e.g., Ex. 1003 ¶ 68; quoting Ex. 1009 ¶¶ 15, 17, 25, Figs. 1, 2, 4A, 4B). Accordingly, Petitioner contends that a person of ordinary skill in the art would have modified Aizawa's sensor to include a cover with a protruding convex surface, as taught by Ohsaki, that is “between a surface of the sensor and the user's wrist.” Pet. 20–22 (citing, e.g., Ex. 1003 ¶¶ 67–70).

Petitioner contends this modification would have been “nothing more than the use of a known technique to improve similar devices in the same way,” i.e., “when Ohsaki's PMD is worn ‘the convex surface of the translucent board . . . is in intimate contact with the . . . user's skin’; this contact prevents slippage, which increases the strength of the obtainable signals.” Pet. 20–21 (citing Ex. 1003 ¶¶ 67–68).

To illustrate its proposed modification, Petitioner includes two annotated versions of Aizawa's Figure 1(b), both of which are reproduced below. Pet. 19–23 (citing Ex. 1003 ¶¶ 66–70).



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FIG. 1 (b)

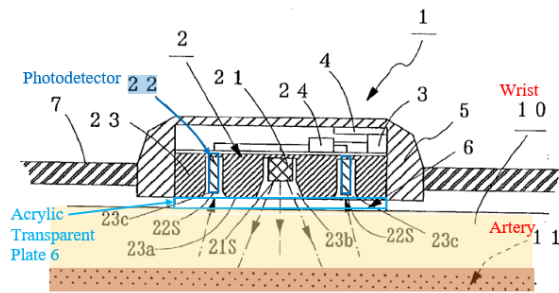
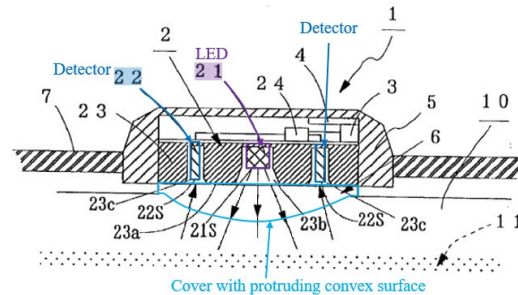


FIG. 1 (b)



Petitioner's annotated figure on the left depicts Aizawa's sensor, modified to include a flat "acrylic transparent plate" (illustrated with blue outline); Petitioner's annotated figure on the right depicts Aizawa's sensor, modified to include a "cover with protruding convex surface" (illustrated with blue outline).

### Patent Owner's Arguments

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Aizawa's sensor to include Ohsaki's convex cover. PO Resp. 16–46;<sup>5</sup> Sur-reply 3–25.

First, Patent Owner argues "Ohsaki's rectangular board would be incompatible with Aizawa's circular sensor arrangement" and that the proposed modification "eliminates the longitudinal shape that Ohsaki specifically identifies as important for the benefit of reducing slipping." PO Resp. 16–18 (emphases omitted). This argument is premised on Patent

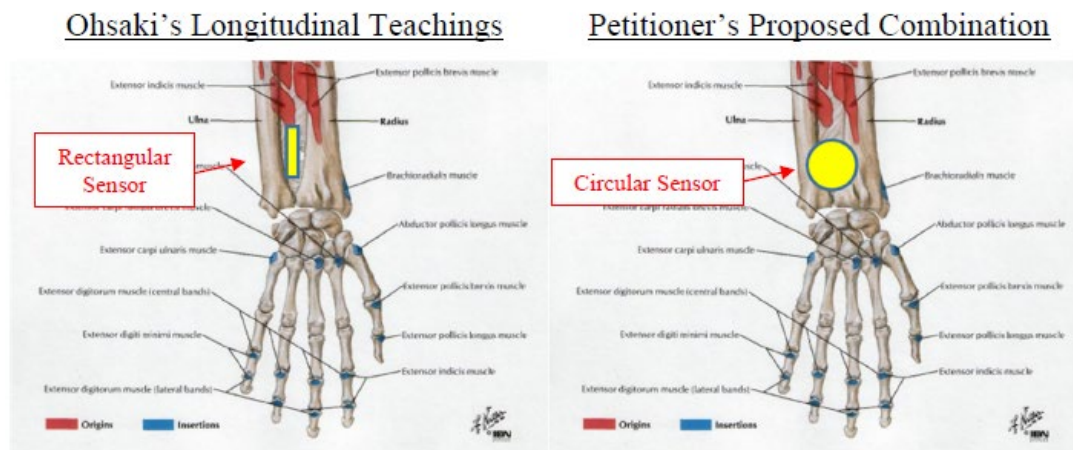
<sup>5</sup> Patent Owner further argues, "[t]o the extent Petitioner contends a [person of ordinary skill in the art] would use Ohsaki's rectangular board on Aizawa's circular sensor . . . , that argument is unsupported and incorrect." PO Resp. 23 (emphasis omitted). We do not read the Petition as making such a contention. We understand Petitioner to propose, in essence, changing Aizawa's circular *flat* cover into a circular *convex* cover. See, e.g., Pet. 22–23.

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Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 18–23 (citing, e.g., Ex. 2004 ¶¶ 48–55; Ex. 1009 ¶¶ 6, 19, 23–25); *see also* Sur-reply 3–11. According to Patent Owner, Ohsaki teaches that “aligning the sensor's longitudinal direction with the circumferential direction of the user's arm undesirably results in ‘a tendency [for Ohsaki's sensor] to slip off.’” PO Resp. 19 (emphasis omitted) (alteration in original) (citing Ex. 1009 ¶ 19).

Thus, Patent Owner contends that Petitioner's proposed modification would “chang[e] Ohsaki's rectangular board into a circular shape,” which “would eliminate the advantages discussed above” because it “cannot be placed in any longitudinal direction and thus [could not] coincide with the longitudinal direction of the user's wrist.” *Id.* at 20–21 (emphases omitted) (citing Ex. 2004 ¶¶ 50–51). Patent Owner presents annotated Figures depicting what it contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below.



Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated

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Figure on the right depicts a circular sensor placed across a user's radius and ulna. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus [would not] avoid [the] undesirable interaction with the user's bone structure," such that a skilled artisan "would have understood that any such change would eliminate Ohsaki's benefit of preventing slipping." PO Resp. 21–23 (citing, e.g., Ex. 2004 ¶¶ 48–55).

Patent Owner additionally argues that "changing Aizawa's circular sensor to accommodate Ohsaki's longitudinal structure would result in less consistent measurements" and would "disrupt Aizawa's circular symmetry." *Id.* at 2. This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular. *Id.* at 23 (citing Ex. 2004 ¶ 57). According to Patent Owner, "placing Ohsaki's rectangular board onto Aizawa's circular sensor would result in undesirable asymmetrical pressure and inconsistent contact at the peripheral edge where Aizawa's detectors are located," which would "create air gaps over some of Aizawa's peripherally arrayed detectors, but not others, which could result in degraded optical signals." *Id.* at 24–25 (emphasis omitted) (citing Ex. 2004 ¶¶ 58–59). Thus, Patent Owner argues that a person of ordinary skill in the art "would not have been motivated to use Ohsaki's rectangular board with Aizawa's circular sensor." *Id.* at 25 (citing Ex. 2004 ¶¶ 58–59).

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Aizawa's sensor. PO Resp. 25–26. Specifically, Patent Owner argues that Aizawa's sensor must be worn on the palm side of the wrist, close to radial and ulnar arteries, which is the side

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opposite from where Ohsaki's sensor is worn. *Id.* at 26–32 (citing, e.g., Ex. 1006 ¶¶ 2, 7, 9, 26, 27, 36; Ex. 2004 ¶¶ 60–67). According to Patent Owner, Ohsaki teaches that the sensor's convex surface has a tendency to slip when placed on the palm side of the wrist, i.e., in the location taught by Aizawa. *Id.* at 32–35 (citing, e.g., Ex. 1009 ¶¶ 19, 23–24; Ex. 2004 ¶¶ 68–80). Thus, Patent Owner argues that a person of ordinary skill in the art “would not have been motivated to use Ohsaki's longitudinal board—designed to be worn on the back side of a user's wrist—with Aizawa's palm-side sensor.” *Id.* at 35 (emphases omitted). Similarly, Patent Owner argues that Aizawa teaches away from the proposed modification because Aizawa teaches that its flat acrylic plate improves adhesion on the palm side of the wrist, while Ohsaki teaches that its convex board “has a tendency to slip” on the palm side of the wrist. *Id.* at 35–38 (citing, e.g., Ex. 2004 ¶¶ 75–78).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Aizawa's peripheral detectors because the convex cover would condense light toward the center and away from Aizawa's detectors, which would decrease optical signal strength. PO Resp. 38–44 (citing, e.g., Ex. 2004 ¶¶ 79–88). Patent Owner also contends that Petitioner and Dr. Kenny admitted as much in a related proceeding. *Id.* at 39–40 (citing, e.g., Ex. 2019, 45; Ex. 2020, 69–70). Patent Owner also relies on Figure 14B of the '564 patent to support its position. *Id.* at 40 (citing Ex. 1001, 36:12–15, 36:23–25). In light of the foregoing, Patent Owner argues that a person of ordinary skill in the art would have understood that the proposed modification would have decreased signal strength by directing light away from Aizawa's peripheral detectors. *Id.* at 43.

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Fourth and finally, Patent Owner argues that a person of ordinary skill in the art “would have understood that Aizawa’s flat plate would provide better protection than a convex surface” because it “would be less prone to scratches.” *Id.* at 44–46 (citing Ex. 1008 ¶ 106; Ex. 2004 ¶ 90) (emphasis omitted).

### Petitioner’s Reply

Concerning Patent Owner’s first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve the disclosed benefits. Pet. Reply 7–20 (citing, e.g., Ex. 1050 ¶¶ 7–30). Moreover, Petitioner asserts that “even if Ohsaki’s translucent board 8 were [somehow] understood to be rectangular, obviousness does not require ‘bodily incorporation’ of features from one reference into another”; rather, a person of ordinary skill in the art “would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the benefits” taught by Ohsaki. *Id.* at 15–16 (citing, e.g., Ex. 1050 ¶ 23). Similarly, regarding the location of the sensor, Petitioner asserts,

[E]ven assuming for the sake of argument that a [person of ordinary skill in the art] would have understood Aizawa’s sensor as being limited to placement on the backside of the wrist, and would have understood Ohsaki’s sensor’s “tendency to slip” when arranged on the front side as informing consideration of Ohsaki’s teachings with respect to Aizawa, that would have further motivated the [person of ordinary skill in the art] to implement a light permeable convex cover in Aizawa’s sensor, to improve detection efficiency of that sensor when placed on the palm side.

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*Id.* at 18 (citing, e.g., Ex. 1050 ¶ 25) (emphasis omitted). In other words, Ohsaki’s disclosure that a convex surface suppresses variation in reflected light would have motivated an artisan to add such a surface to Aizawa to improve detection efficiency of that sensor when placed on the palm side. *Id.* at 18.

Concerning Patent Owner’s third argument, Petitioner responds that adding a convex cover to Aizawa’s sensor would not decrease signal strength but, instead, “would improve Aizawa’s signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa’s photodetectors than would have with a flat cover” because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 20–21 (citing, e.g., Ex. 1050 ¶¶ 31–34).

Petitioner asserts that Patent Owner and Dr. Madisetti “ignore[] the well-known principle of reversibility,” by which “a ray going from P to S will trace the same route as one from S to P.” Pet. Reply 22 (quoting Ex. 1051, 84, 92; Ex. 1052, 101, 110; Ex. 1053, 80:20–82:20). When applied to Aizawa’s sensor, Petitioner contends that any condensing benefit achieved by a convex cover would thus direct emitted light toward Aizawa’s peripheral detectors. *Id.* at 22–24 (citing, e.g., Ex. 1050 ¶¶ 35–43).

Although Dr. Madisetti refused to acknowledge “this basic principle of reversibility during deposition,” Petitioner contends this core concept of reversibility is applied in Aizawa. *Id.* at 24–25 (citing, e.g., Ex. 1006 ¶ 33; Ex. 1050 ¶ 44; Ex. 1055, 209:19–21).

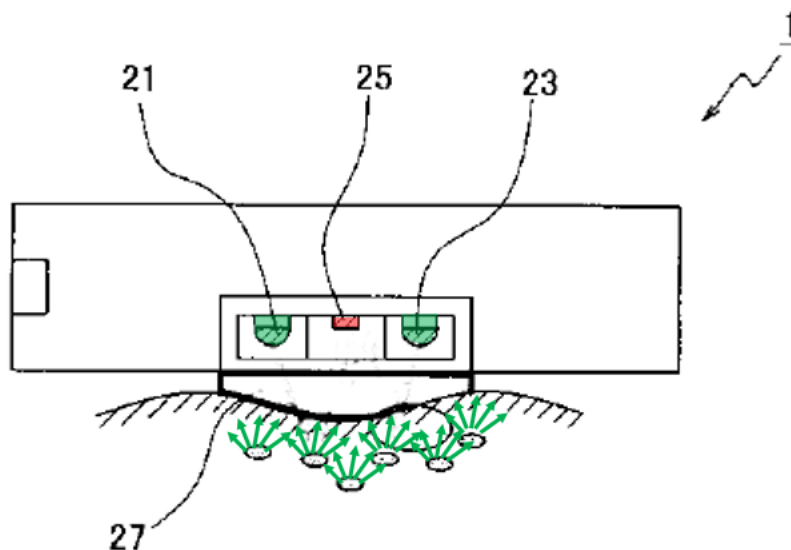
Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue will be scattered and diffuse and will approach the detectors “from various random directions and

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angles.” Pet. Reply 25–29 (citing, e.g., Ex. 1021, 52, 86, 90; Ex. 1050 ¶¶ 42–47; Ex. 1051, 841; Ex. 1052, 101; Ex. 1053, 80:20–82:20). This scattered and diffuse light, according to Petitioner, means that Ohsaki’s convex cover cannot “focus all light at the center of the sensor device,” as Patent Owner argues. *Id.* at 26. Instead, due to the random nature of this scattered light, Petitioner asserts that a person of ordinary skill in the art would have understood that “Ohsaki’s convex cover provides a slight refracting effect, such that light rays that may have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.” *Id.* at 27 (citing, e.g., Ex. 1050 ¶ 50). Petitioner applies this understanding to Aizawa, and asserts that using a cover with a convex protrusion in Aizawa would “enable backscattered light to be detected within a circular active detection area.” *Id.* (citing, e.g., Ex. 1021, 86, 90; Ex. 1050 ¶ 49).

Petitioner relies upon the following illustration of this alleged effect. Pet. Reply 30 (citing Ex. 1050 ¶ 54).



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The above illustration depicts backscattered light with Aizawa's sensor reflecting off user tissue in various directions, such that it impinges upon the peripheral detectors from various random angles and directions. *Id.*

According to Petitioner, this allows the detector to capture "light rays that otherwise would have missed the active detection area are instead directed toward that area." *Id.* at 31 (citing Ex. 1050 ¶ 55).

Petitioner also dismisses Patent Owner's reliance on Figure 14B of the '564 patent because it "is not an accurate representation of light that has been reflected from a tissue measurement site." Pet. Reply 28 (citing, e.g., Ex. 1050 ¶¶ 51–52). According to Petitioner, for example, "[t]he light rays (1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to one another), and each light ray's path is perpendicular to the detecting surface." *Id.* at 28–29.

Concerning Patent Owner's fourth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the "known advantages of applying Ohsaki's teachings," and would not negate a motivation to combine. *Id.* at 33 (citing, e.g., Ex. 1050 ¶ 60).

#### Patent Owner's Sur-reply

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that "even small changes in sensor orientation or measurement location result in slippage." Sur-reply 1, 3–15, 8.

Concerning Patent Owner's third argument (that the convex cover would condense light toward the center and away from Aizawa's detectors),



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Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 15–16, 19–21. Patent Owner asserts that Petitioner’s Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *Id.* at 16–19 (regarding reversibility). Moreover, Patent Owner argues that Petitioner’s discussion of the principle of reversibility is “irrelevant” because it “assumes conditions that are not present when tissue scatters and absorbs light.” *Id.* at 16–17. The random nature of backscattered light, in Patent Owner’s view, “hardly supports Petitioner’s argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed,” and is irrelevant to the central issue presented here of “whether changing Aizawa’s flat surface to a convex surface results in more light on Aizawa’s peripherally located detectors.” *Id.* at 18.

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner’s position, which is not that Ohsaki’s cover with a convex protrusion “focuses *all* light to a single point” at the center of the sensor as Petitioner characterizes it. Sur-reply 20. Patent Owner’s position, rather, is that Petitioner has not shown that a person of ordinary skill in the art “would have been motivated to change Aizawa’s flat surface to a convex surface to improve signal strength.” *Id.* In Patent Owner’s view, by arguing that the convex cover provides only a “slight refracting effect,” Petitioner undermines its contention that providing such a cover would have improved detection efficiency. *Id.* at 20–21 (emphasis omitted).

Patent Owner also argues that Petitioner’s contention that a convex cover allows more light collection generally is a new theory not supported

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by Dr. Kenny’s original declaration. *Id.* at 20. Moreover, Patent Owner argues that Petitioner’s theory is “unavailing because it fails to consider the greater decrease in light at the detectors due to light redirection to a more central location.” *Id.* at 21 (emphasis omitted). According to Patent Owner, any light redirected from the sensor’s edge could not make up for the loss of signal strength from light redirected away from the detectors and toward the center. *Id.*

Concerning Patent Owner’s fourth argument, Patent Owner argues that Petitioner does not dispute Patent Owner’s position that a flat cover would be less prone to scratches and offers “***no*** plausible advantages for its asserted combination.” *Id.* at 24. Moreover, Patent Owner argues that the risk of scratches undermines Petitioner’s argument of adding a convex cover to protect the elements within the sensor housing. *Id.* at 25.

### Analysis

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided “a light permeable cover with a protruding convex surface,” such as that taught by Ohsaki, to Aizawa’s sensor: (1) to improve adhesion between the sensor and the user’s tissue; (2) to improve detection efficiency; and (3) to protect the elements within the sensor housing. Pet. 20–23 (citing, e.g., Ex. 1003 ¶¶ 67–70; Ex. 1009 ¶ 25). As further examined below, we determine all three rationales are supported by the evidence, and further that any single rationale standing alone would have been sufficient to establish a basis for the person of ordinary skill in the art to combine the references as proposed.

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Rationales 1 and 2

The evidence of record persuades us that adding a convex cover, such as that taught by Ohsaki, would have improved adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.* Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25 (emphasis added); *see also id.* ¶ 27 (“detecting element 2 is stably fixed”).

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Aizawa to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist and to suppress variation. *See, e.g.,* Ex. 1003 ¶¶ 68 (“[T]his contact between the convex surface and the user's skin prevents slippage, which increases the strength of the signals obtainable by Ohsaki's [sensor].”), 70, 103 (One of ordinary skill would have understood that this “would have been used to realize improved adhesion between the user's

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wrist and the sensor’s surface, improve detection efficiency.”). We find persuasive Dr. Kenny’s explanation that the person of ordinary skill in the art “would have understood that a protruding convex cover would reduce the adverse effects of user movement on signals obtainable by photodetectors which are positioned to detect light reflected from user tissue.” Ex. 1050 ¶ 13.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1009, Figs. 4A–4B, ¶¶ 15, 25 (stating that with “a flat surface, the detected pulse wave is adversely affected by the movement of the user’s wrist 4,” and with “a convex surface like the present embodiment, the variation of the amount of the reflected light” collected by the sensor “is suppressed”). Ohsaki also states that, with a convex surface, “[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.” *Id.* ¶ 25.

We also credit Dr. Kenny’s testimony that the proposed modification would have been within the skill level of an ordinary artisan. For example, Dr. Kenny testifies that one of ordinary skill in the art would have combined the teachings of Aizawa and Ohsaki as “[d]oing so would have amounted to nothing more than the use of a known technique to improve similar devices in the same way and combining prior art elements according to known methods to yield predictable results.” Ex. 1003 ¶ 67. In particular, one of ordinary skill in the art would have recognized that by incorporating Ohsaki’s convex surface, “the convex surface of the translucent board . . . is

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in intimate contact with the surface of the user's skin'; this contact between the convex surface and the user's skin prevents slippage, which increases the strength of the signals obtainable by Ohsaki's [sensor]." *Id.* ¶ 68 (citing Ex. 1009 ¶¶ 15, 17, 25, Figs. 1, 2, 4A, 4B).

In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through third arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user's forearm. PO Resp. 8–25. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1009 ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex protrusion.

We disagree with Patent Owner's suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki's Figures 1 and 2. PO Resp. 10–11. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex

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surface. *See, e.g.*, Ex. 1009 ¶ 13 (“schematic diagram”); *see also* Pet. Reply 12–15; *Hockerson-Halberstadt, Inc. v. Avia Group Int’l*, 222 F.3d 951, 956 (Fed. Cir. 2000) (“[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.”).

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: “[T]he length of the detecting element 2 from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side.” Ex. 1009 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user’s forearm: “[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user’s arm,” to avoid slipping off. *Id.*; *see also id.* ¶ 9 (“The light emitting element and the light receiving element are arranged in the longitudinal direction of the user’s arm.”).

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki’s convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner’s argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 12–13 (noting also that Ohsaki’s board 8 “is not coextensive with the entire tissue-facing side of detecting element 2”). We have considered the testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1050 ¶¶ 8, 11–12, 18–23; Ex. 2004 ¶¶ 35–39 (relying on Ohsaki’s Figures 1–2 to support his opinion that the convex surface is rectangular). Dr. Madisetti’s reliance on the dimensions of Ohsaki’s figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956.

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We credit Dr. Kenny's testimony that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. PO Resp. 18–23; Sur-reply 10 (“[A] POSITA would have understood Ohsaki's convex board must also have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm.”) (emphasis omitted). Although Ohsaki recognizes that interaction with these bones can cause problems, *see* Ex. 1009 ¶¶ 6, 19, we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 21, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. “A person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all.

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Moreover, even if Ohsaki's convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." Ex. 1009 ¶ 25; Ex. 1050 ¶ 18. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's circular-shaped sensor, to improve adhesion as taught by Ohsaki. *See, e.g.*, Pet. 20–23. Nothing in Ohsaki's disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1050 ¶¶ 10–11, 14–23.

Moreover, Ohsaki contrasts the ability to properly receive reflected light with a convex surface as compared to a flat surface and notes that,

in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25; Ex. 1050 ¶¶ 12–13. Again, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's sensor, to improve signal strength, as taught by Ohsaki. *See, e.g.*, Pet. 21–23. Again, nothing



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in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1050 ¶¶ 10–11, 14–23.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Aizawa and Ohsaki.

We have also considered Patent Owner's arguments that Petitioner's proposed modification would disrupt Aizawa's "circular symmetry." See PO Resp. 23–25. We do not agree. Rather we agree with Petitioner that the proposed modification is not a bodily incorporation. That is, Petitioner does not propose a bodily incorporation of Ohsaki's rectangular board into Aizawa's circular cover. Pet. Reply 15–16. Petitioner proposes modifying Aizawa only to include a cover with a convex surface. Pet. 20. We agree with Petitioner that a person of ordinary skill in the art, "is also a person of ordinary creativity, not an automaton," and is capable of modifying Aizawa to, *inter alia*, minimize any gap when including a cover with a convex surface. Indeed, a purpose of Petitioner's proposed modification is to increase signal strength. See, e.g., Pet. 21–23. We discern that it would have been within the capability of an ordinarily skilled artisan to eliminate any gap that would have decreased signal strength or quality. Ex. 1050 ¶ 29.

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is the opposite side of the wrist taught by Aizawa. PO Resp. 25–38. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. See, e.g., Pet. 20. In other words,

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Petitioner’s proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki’s Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when the element is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1009 ¶¶ 23–24, Figs. 3A–3B. However, we do not agree that these figures support Dr. Madisetti’s conclusion that “Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different locations or orientations” such as the palm side of the wrist—particularly in comparison to a flat surface such as Aizawa’s. Ex. 2004 ¶¶ 60, 73. Instead, Ohsaki acknowledges that, even when the detecting element is located “on the front [palm] side of the user’s wrist 4, *the pulse wave can be detected well* if the user is at rest.” Ex. 1009 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user’s wrist achieves benefits. *Id.* Notably, Ohsaki’s claims are not limited to detection during movement or exercise.

We credit, instead, Dr. Kenny’s testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa’s sensor. *See* Ex. 1050 ¶¶ 10–11, 24–30. This is because the convex protrusion “promot[es] ‘intimate contact with the surface of the user’s skin,’” which “would have increased adhesion and reduced slippage of Aizawa’s sensor when placed on either side of a user’s wrist or forearm, and additionally

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would have provided associated improvements in signal quality.” *Id.* ¶¶ 29–30 (“additional adhesive effect”).

Dr. Madisetti testifies that

[b]ased on Aizawa’s teaching that a flat acrylic plate improves adhesion on the palm side of the wrist, and Ohsaki’s teaching that a convex surface tends to slip on the palm side of the wrist, a [person of ordinary skill in the art] would have come to the opposite conclusion from Dr. Kenny: that modifying Aizawa’s flat adhesive plate “to include a lens/protrusion . . . similar to Ohsaki’s translucent board” would not “improve adhesion.”

Ex. 2004 ¶ 78 (emphasis omitted); *see also id.* ¶ 76. We disagree with this reading of Aizawa. It is true that Aizawa’s plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate “improve[s] adhesion” (*id.* ¶ 13). Aizawa further states: “the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10,” and “[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.” *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *See also id.* ¶¶ 30, 34 (“Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved.”). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with. Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa’s detector to the user’s wrist.

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We have considered Patent Owner's third argument that a convex cover would condense light away from Aizawa's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 38–44. We disagree.

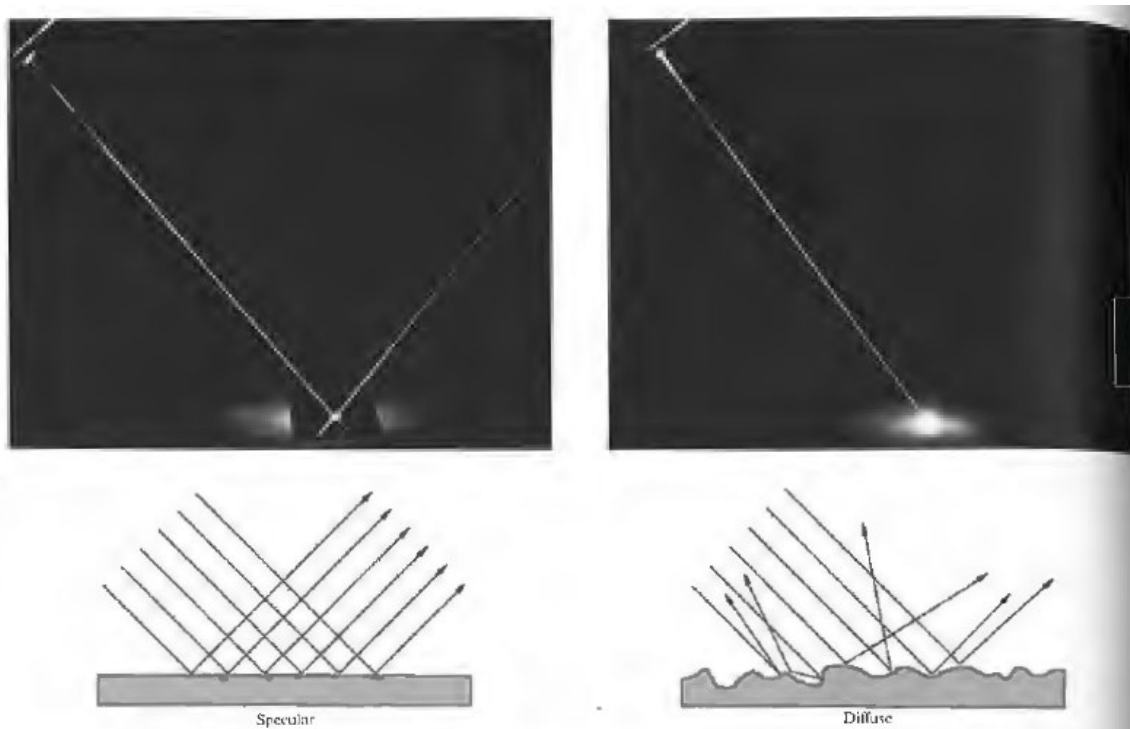
There appears to be no dispute that when emitted light passes through user tissue, the light diffuses and scatters as it travels. *See, e.g.*, Pet. Reply 29 (“[R]eflectance type pulse detectors detect light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector,’” thus, a person of ordinary skill in the art “would have understood from Aizawa’s FIG. 1(a) that light that backscatters from the measurement site after diffusing through tissue reaches the circular active detection area provided by Aizawa’s detectors from various random directions and angles.”) (quoting Ex. 1021, 86); PO Sur-reply 17 (“Even Petitioner admits that tissue randomly scatters and absorbs light rays.”).

The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner. Exhibit 1051,<sup>6</sup> Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:

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<sup>6</sup> Eugene Hecht, *Optics* (2nd ed. 1990).

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This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1051, 87–88 (original page numbers). The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*; *see also* Ex. 1050 ¶ 46 (“A [person of ordinary skill in the art] would have understood that light which backscatters from the measurement site after diffusing through tissue reaches the active detection area [provided] from various random directions and angles.”).

Dr. Kenny testifies that Aizawa “detect[s] light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.’” Ex. 1050 ¶ 46 (quoting

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Ex. 1021, 86). Dr. Kenny further opines that a convex cover, when added to Aizawa's sensor with multiple detectors symmetrically arranged about a central light source, allows light rays that otherwise would have missed the detection area to instead be directed toward that area as they pass through the interface provided by the cover, thus increasing the light-gathering ability of Aizawa's sensor. *Id.* ¶¶ 46–49.

By contrast Dr. Madisetti testifies that “a convex [surface] condenses light passing through it towards the center of the sensor and away from the periphery.” Ex. 2004 ¶ 80; *see also id.* ¶¶ 80–82, 86. We have considered this testimony, however, Dr. Madisetti's opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* ¶ 82. Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 84–88. In other words, even if Patent Owner is correct that the '564 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light reflected by a user's tissue is scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that “Petitioner and Dr. Kenny both admit that a convex cover condenses light towards the center of the sensor and away from the periphery,” in a different petition filed against a related patent, i.e., in IPR2020-01520. PO Resp. 39–41; Ex. 2004 ¶¶ 80–83. The cited portions of the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the “mean path length” of a ray of light when it travels through a convex lens rather than through a flat surface.

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*See, e.g.,* Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny’s testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Aizawa’s symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. *See, e.g.,* Ex. 1050 ¶¶ 49, 55 (“Ohsaki’s convex cover provides a slight refracting effect, such that light rays that may have otherwise missed the detection area are instead directed toward that area”). We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface.

We additionally do not agree with Patent Owner’s argument that Petitioner’s Reply presents new arguments and evidence that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. *See* Sur-reply 16–19. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa’s device. *See* Pet. 19–23. The Patent Owner Response then challenged that contention, with several arguments that Petitioner’s proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See* PO Resp. 38–44. This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide

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(Nov. 2019) (“Consolidated Guide”),<sup>7</sup> 73 (“A party also may submit rebuttal evidence in support of its reply.”). This is what Petitioner did here. The Reply does not change Petitioner’s theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 19–23, *with* Pet. Reply 20–32.

### Rationale 3

Petitioner further contends that a person of ordinary skill in the art would have recognized that a cover with a protruding convex surface, such as that taught by Ohsaki, would “protect the elements within the sensor housing” of Aizawa. Pet. 47. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would also protect the sensor’s internal components in a manner similar to Aizawa’s flat acrylic plate. Ex. 1003 ¶ 70; *see also* Ex. 1008 ¶ 15 (noting that a cover “protect[s] the LED or PD”).

We disagree with Patent Owner’s fourth argument that a person of ordinary skill in the art would not have modified Aizawa as proposed because a convex cover would be prone to scratches and because other alternatives existed. Patent Owner does not explain how the potential presence of scratches on a convex cover would preclude that cover’s ability to, nonetheless, protect the internal sensor components in Aizawa, as Petitioner proposes. That a convex cover may be more prone to scratches than Aizawa’s flat cover is one of numerous tradeoffs that a person of ordinary skill in the art would consider in determining whether the benefits

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<sup>7</sup> Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.



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of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). The totality of the final record does not support that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner’s contentions.

- v. “[Id] one or more processors configured to: receive one or more signals from at least one of the at least four detectors, the one or more signals responsive to at least a physiological parameter of the user; and process the one or more signals to determine measurements of the physiological parameter”

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses one or more processors. Pet. 51–52. According to Petitioner “a [person of ordinary skill in the art] would have understood that Aizawa’s drive detection circuit 24 and arithmetic circuit 3 are ‘one or more processors’ as they receive pulse wave data from the photodetectors and perform signal amplification and calculations to ‘comput[e] a pulse rate from the detected pulse wave data.’” *Id.* at 51 (citing Ex. 1006 ¶¶ 23, 28; Ex. 1003 ¶¶ 107–108).<sup>8</sup>

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<sup>8</sup> Petitioner further contends that Goldsmith also discloses a processor. Pet. 51–52. Because Aizawa teaches components of a computer system that operate on data, consistent with our construction of the term “processor,” further analysis of the combination of Aizawa, Ohsaki, and Goldsmith is not necessary for this particular claim limitation.

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vi. “[1e] a network interface configured to communicate with a mobile phone”

The cited evidence supports Petitioner’s undisputed contention that Goldsmith discloses a network interface configured to communicate with a mobile phone. Pet. 32–35, 53; *see, e.g.*, Ex. 1011 ¶ 52 (“The communications block 595 may be adapted to provide communication via one or more communications methods, such as RF 596, a USB 597, and IR 598.”). In addition, Petitioner provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 35. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 55–60, 75–82, 112.

Petitioner further provides persuasive rationales for the combination of certain Goldsmith features with Aizawa and Ohsaki. Pet. 32–41, 35 (“to incorporate the Aizawa-Ohsaki sensor into Goldsmith’s WCD such that the sensor would have access to a network interface such as Goldsmith’s transceiver or communications block to facilitate remote monitoring, as described in Goldsmith”), 36 (“to incorporate the Aizawa-Ohsaki sensor into Goldsmith’s WCD in such a way as to enable measured pulse rate data to be stored in a storage device and retrieved for subsequent use”).

Patent Owner does not present any argument other than those we have already considered. PO Resp. 46 (“Petitioner does not argue Goldsmith cures the deficiencies in its proposed combination of Aizawa and Ohsaki.”).

vii. “[1f] a touch-screen display configured to provide a user interface”

The cited evidence supports Petitioner’s undisputed contention that Goldsmith discloses a touch-screen display configured to provide a user interface. Pet. 27–32, 53; *see, e.g.*, Ex. 1011 ¶ 86 (“[T]he display is a

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touchscreen display that may be activated by a user's hand.”). In addition, Petitioner provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 29. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 59–60, 76–82, 113.

*viii. “[1g] wherein the user interface is configured to display indicia responsive to the measurements of the physiological parameter”*

The cited evidence supports Petitioner's undisputed contention that Goldsmith discloses the user interface is configured to display indicia responsive to the measurements of the physiological parameter. Pet. 27–32, 53–54. According to Petitioner, Goldsmith's “display 910 displays data directly from the sensor monitors, and data ‘received from a sensor transmitter on the patient's skin.’” *Id.* at 53 (citing Ex. 1011 ¶¶ 86–87, 102, Fig. 9A; Ex. 1003 ¶ 115).

*ix. “[1h] an orientation of the user interface is configurable responsive to a user input”*

The cited evidence supports Petitioner's undisputed contention that Goldsmith discloses an orientation of the user interface is configurable responsive to a user input. Pet. 55–59. According to Petitioner, Goldsmith's “display can be configured in various different ways to allow the interface to be consistent with the user's preferences and to correct the presentation of information that could be incorrect due to the scaling of graphs or incorrect resolutions.” *Id.* at 55–56 (citing Ex. 1011 ¶ 49). Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 118–123.

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- x. “[1i] a wall that surrounds at least the at least four detectors, wherein the wall operably connects to the substrate and the cover”

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses holder 23, which is a wall that surrounds detectors 22, as well as other elements. Pet. 59–60; *see, e.g.*, Ex. 1006 ¶ 23 (“holder 23 for storing . . . light emitting diode 21 and the photodetectors 22”), Fig. 1(b). The cited evidence also supports Petitioner’s undisputed contention that Aizawa’s wall “connects to the substrate and the cover.” Pet. 60–61 (citing Ex. 1006 ¶¶ 23, 30). Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 124–125.

- xi. “[1j] a storage device configured to at least temporarily store at least the measurements of the physiological parameter”

The cited evidence supports Petitioner’s undisputed contention that Goldsmith’s device includes a storage device configured to at least temporarily store at least the measurements of the physiological parameter. Pet. 27–32, 61; *see, e.g.*, Ex. 1011 ¶ 95 (“[T]he heart rate or metabolic rate may be correlated to a level of exercise, such as low, medium or high, to store in the controller device memory.”). Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶ 126.

- xii. “[1k] a strap configured to position the physiological measurement device on the user”

The cited evidence supports Petitioner’s undisputed contention that Goldsmith’s device includes a strap configured to position the physiological measurement device on the user. Pet. 27–32, 61–63; *see, e.g.*, Ex. 1011 ¶ 85, Figs. 9A, 9B (“[D]evice 900 may include a wrist band 940 so that a user may wear the watch controller device 900 on his/her wrist.”).

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*xiii. Summary*

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

*5. Dependent Claims 16 and 17*

Dependent claim 16 ultimately depends from independent claim 1 and further recites “the protruding convex surface protrudes a height between 1 millimeter and 3 millimeters.” Ex. 1001, 46:26–28.

Dependent claim 17 ultimately depends from independent claim 1 and further recites “the protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters.” *Id.* at 46:30–32.

Petitioner contends that the sensor rendered obvious by the combined teachings of Aizawa, Ohsaki, and Goldsmith would have included a cover with a protruding convex surface. *See supra* § II.D.4.iv. With respect to claim 16, Petitioner contends that a person of ordinary skill in the art “would have found it obvious that a device designed to fit on a user’s wrist would be on the order of millimeters,” consistent with Ohsaki’s disclosure that the device is in “intimate contact” with the user’s skin. Pet. 77–78 (citing, e.g., Ex. 1003 ¶¶ 146–147). Petitioner also contends that an ordinarily skilled artisan would have taken user comfort into account when establishing the dimensions of the device’s convex cover. *Id.* at 78–79. With these considerations in mind, Petitioner contends that, “in order to provide a comfortable cover that prevents slippage, the convex surface should protrude a height between 1 millimeter and 3 millimeters,” because “there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable

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to the user.” *Id.* at 79 (citing, e.g., Ex. 1003 ¶¶ 147–148). With respect to claim 17, Petitioner incorporates its contentions regarding, *inter alia*, claim 16. Pet. 79; Ex. 1003 ¶ 149.

Patent Owner argues that none of the cited references disclose the claimed height range and that Petitioner relies on hindsight reconstruction. PO Resp. 47–50 (citing, e.g., Ex. 2004 ¶¶ 93–97). Patent Owner also characterizes Dr. Kenny’s testimony as conclusory and unsupported. *Id.* at 50–51. Patent Owner also alleges that the benefit “of reducing the main optical path lengths” is achieved at these dimensions. Tr. 31:8–15.

Petitioner is correct that, “[w]hen there . . . are a finite number of identified, predictable solutions, a person of ordinary skill [in the art] has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense.” *KSR*, 550 U.S. at 421. Petitioner has shown sufficiently that only a finite number of solutions existed with respect to the height of a convex protrusion on a tissue-facing sensor, which would have met the art-recognized goals of both (1) intimate contact between the sensor’s surface and the user and (2) user comfort. *See, e.g.*, Ex. 1009 ¶¶ 6, 25. Bearing in mind these considerations, we credit Dr. Kenny’s testimony that it would have been obvious, “in order to provide a comfortable cover that prevents slippage, [that] the convex surface should protrude a height between 1 millimeter and 3 millimeters,” as recited in claim 16, and which further includes the claimed range of 2 to 3 millimeters as recited in claim 17. Ex. 1003 ¶ 148. Further, the record does not support that any new and unexpected results were achieved at the claimed height greater than 2 millimeters and less than 3 millimeters. *See, e.g.*, Ex. 1001, 23:43–50 (“The

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height 430 can be from about 0.5 millimeters to about 3 millimeters, e.g., about 2 millimeters. In an embodiment, the dimensions 400, 410, and 430 can be selected such that the measurement site contact area 470 includes an area of about 80 square millimeters, although larger and smaller areas can be used for different sized tissue for an adult, an adolescent, or infant, or for other considerations.”).

We have considered Patent Owner’s argument, and Dr. Madisetti’s cited testimony. However, it is not dispositive that none of Aizawa, Ohsaki, or Goldsmith teaches the claimed range. PO Resp. 48–50; Ex. 2004 ¶¶ 95–97. Petitioner relies upon the knowledge, ability, and creativity of a person of ordinary skill in the art, not the teachings of a specific reference. Notably, Dr. Madisetti does not dispute Dr. Kenny’s position that there were a finite number of options available for the height of the convex surface. Ex. 2004 ¶¶ 95–98. Therefore, we do not agree that Petitioner’s contentions are rooted in impermissible hindsight. *See, e.g., In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) (“Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.”). As for the alleged benefit at the specific ranges described in the Specification, we agree with Petitioner that other considerations are relevant, such as user comfort and other attributes, that would have motivated a person of ordinary skill in the art to design within the claimed ranges. *See* Tr. 80:7–14; Ex. 1001, 23:43–50.

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Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 16 and 17 would have been obvious over the cited combination of references.

*6. Dependent Claims 2–10, 13–15, and 18–30*

Petitioner also contends that claims 2–10, 13–15, and 18–30 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 64–77, 80–91. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 129–145, 150–170.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 46–47 (“[T]he Petition fails to establish that independent claim 1 is obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims.”).

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–10, 13–15, and 18–30 would have been obvious over the combined teachings of Aizawa, Ohsaki, and Goldsmith for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.



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For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–10 and 13–30 would have been obvious over the cited combination of references.

*E. Obviousness over the Combined Teachings of  
Aizawa, Ohsaki, Goldsmith, and Sherman*

Petitioner contends that claim 11 of the '564 patent would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, and Sherman. Pet. 91–95; *see also* Pet. Reply 37–40. Patent Owner disagrees. PO Resp. 51–52; *see also* Sur-reply 27–28.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claim 11 is unpatentable.

*1. Sherman (Ex. 1013)*

Sherman is a patent titled “Magnetic Clasp for Wristwatch Strap,” and it relates to use of magnetizable material embedded in thermoplastic material with rows of alternating magnetic poles. Ex. 1013, codes (54), (57). Sherman discloses a magnetic fastening mechanism for “wrist instruments,” such as wristwatches. *Id.* at 1:4–10. Sherman's system provides “an improved clasp for a flexible strap which eliminates buckles or other types of protruding mechanisms” and is “secured, yet easy to engage when desired.” *Id.* at 2:1–11. As shown below in Figure 2 of Sherman, the mechanism includes a pair of flexible strap ends having “permanently magnetizable material” of opposite polarities in addition to “mutually nesting uniformly spaced protuberances and indentations.” *Id.* at 2:43–62, Fig. 2.

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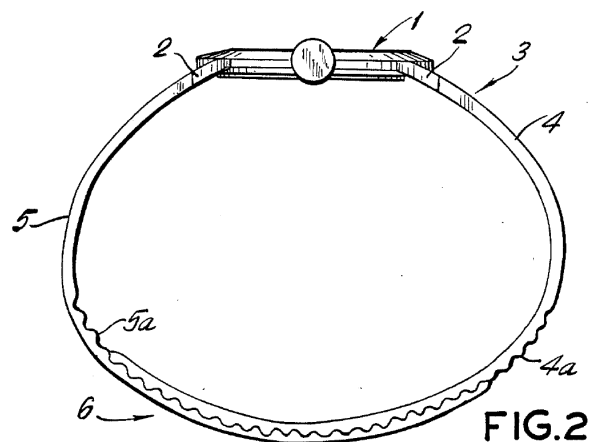


Figure 2 of Sherman depicts an end elevational view showing the wristwatch and strap with transverse ridges 4a and 5a incorporating magnetic securing materials. *Id.*

## 2. Dependent Claim 11

Claim 11 additionally requires “a magnet configured to be used as a connecting mechanism.” Ex. 1001, 46:8–9. Petitioner contends that it would have been obvious for a person of ordinary skill in the art to have modified the sensor system of Aizawa-Ohsaki-Goldsmith to integrate a magnetic connection as taught by Sherman. Pet. 93–95.

### Petitioner’s Contentions

Petitioner contends that although Goldsmith generally discloses a fastener, Goldsmith “provides no details describing the fastener,” but that a person of ordinary skill in the art “would have been motivated to look to other wearable, wrist worn devices such as Sherman’s, for details regarding a mechanism for fastening a monitoring device.” Pet. 93 (citing Ex. 1003 ¶ 171). Petitioner contends a person of ordinary skill in the art would have been motivated to add Sherman’s magnetic connection in order to be more

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visually appealing, prevent corners from catching upon clothing, and to prevent broken connectors or accidental snagging. *Id.* (citing Ex. 1013, 1:11–24; Ex. 1003 ¶ 171).

#### Patent Owner's Contentions

Patent Owner disputes Petitioner's contentions. Patent Owner argues that Petitioner's proposed combination relies on Sherman solely for its alleged disclosure of a magnetic connector, but Ohsaki already includes a series of dedicated belts designed to exert a specific pressure on the user's wrist. PO Resp. 51 (citing Ex. 1009 ¶ 18). Patent Owner alleges that a person of ordinary skill in the art would have understood that any advantage from Ohsaki's convex board would also require Ohsaki's specific attachment arrangement, which includes belts and a cushion to prevent movement, yet, Petitioner does not explain how Sherman would have allowed consistent attachment pressure for its sensor as required by Ohsaki. *Id.* at 52 (citing Ex. 1009 ¶ 18); *see also* Sur-reply 27 ("Ohsaki uses specific dedicated belts to keep sensor body, detecting element, and cushion aligned."). Thus, Patent Owner contends that the person of ordinary skill in the art "would not have been motivated to incorporate Sherman's magnetic attachment mechanism into Petitioner's proposed combination." PO Resp. 52 (citing Ex. 2004 ¶ 101); *see also* Sur-reply 27–28.

#### Analysis

We are persuaded by Petitioner's evidence and argument that a person of ordinary skill in the art would have been motivated to combine Sherman's teaching of a magnetic connection in the existing combination of references. We find persuasive Dr. Kenny's testimony that a person of ordinary skill in

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the art would have understood from Ohsaki itself that a cushion designed to exert a specific pressure is not required to obtain the benefits described in relation to Ohsaki's board. Ex. 1050 ¶¶ 67–69 (noting that Ohsaki's cushion is on the back side whereas the modified connection “would be on the front side”) (citing Ex. 1009, Fig. 1). Further, we are persuaded by Dr. Kenny's testimony that “[t]he combination involves nothing more than applying a known technique to fasten two ends of a strap for attaching a wrist worn device to a user's arm.” Ex. 1003 ¶ 174. In light of the totality of the record, including Dr. Kenny's testimony, we determine that a person of ordinary skill in the art would have been motivated to employ Sherman's magnetic connector because the pressure range required for Ohsaki's benefits could be achieved by any number of connection fastening mechanisms.

Further, Patent Owner's arguments do not persuasively address Petitioner's proposed combination. *See* Pet. 19–23, 91–95. Ohsaki was relied upon for its teaching that a convex surface protruding into a user's skin will, *inter alia*, prevent slippage. *See id.*; *see also* Ex. 1050 ¶ 73; Ex. 1009, 25, Figs. 4A, 4B. As discussed above, we found persuasive Dr. Kenny's testimony that a person of ordinary skill in the art would have had reason, in view of that teaching, to modify the Aizawa's sensor's flat cover to include a protrusion, so as to improve adhesion between the user's wrist and the sensor's surface, improve detection efficiency, and protect the elements within the sensor housing. *See* Ex. 1003 ¶¶ 103–106. The resulting sensor features Aizawa's cover modified in view of Ohsaki, but does not include Ohsaki's belt connector. Ex. 1050 ¶ 7. Likewise, Patent Owner does not effectively rebut Dr. Kenny's testimony that a person of

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ordinary skill in the art would have integrated a magnetic connector in the combination of references in view of Sherman for reasons related to engagement and user comfort. *See* PO Resp. 51–52; Ex. 1003 ¶¶ 173–174 (“because it provided details of a wrist-worn device fastening mechanism that addresses the above-noted problems, is easy to engage, and improves user comfort”); Ex. 1050 ¶¶ 68–69.

### 3. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 11 would have been obvious over the cited combination of references.

#### *F. Obviousness over the Combined Teachings of Aizawa, Ohsaki, Goldsmith, and Rantala*

Petitioner contends that claim 12 of the ’564 patent would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, and Rantala. Pet. 95–99; *see also* Pet. Reply 40. Patent Owner disagrees. PO Resp. 51–52;<sup>9</sup> *see also* Sur-reply 28.

Based on our review of the parties’ arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claim 12 is unpatentable.

#### 1. Rantala (Exhibit 1022)

Rantala is a patent titled “Pulse Oximeter,” and it relates to minimizing the power consumption in a pulse oximeter without

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<sup>9</sup> Although Patent Owner’s heading lists Grounds 2 and 3, Patent Owner only discusses ground 2.

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compromising on performance. Ex. 1022, codes (54), (57). Figure 1 of Rantala is reproduced below.

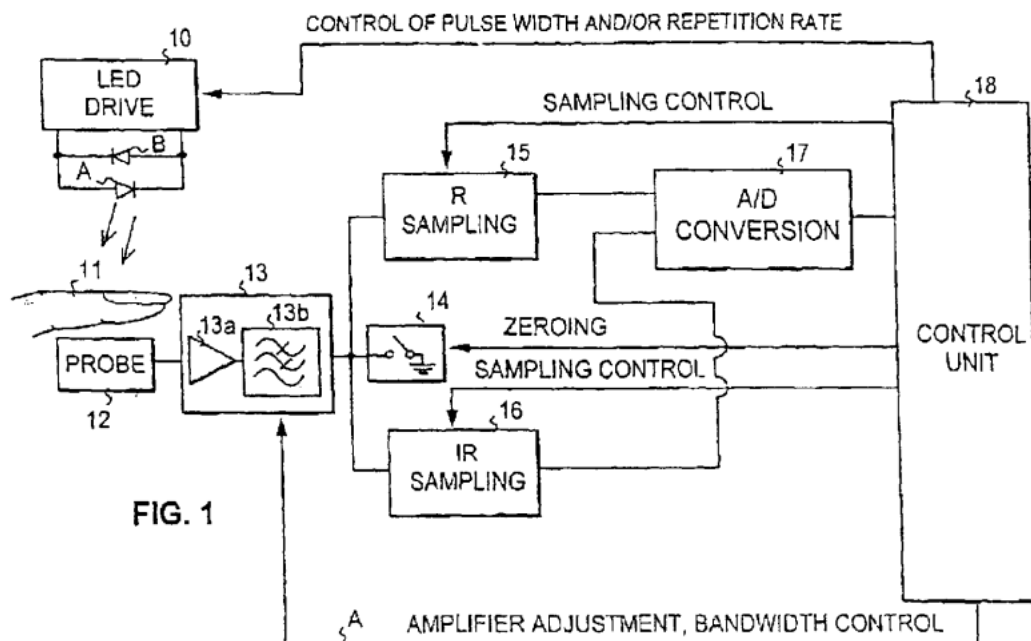


Figure 1 illustrates an exemplary pulse oximeter. *Id.* at 4:26–27. As depicted in Figure 1, Rantala’s pulse oximeter includes a control unit 18 connected to a LED Drive 10 that drives LEDs A and B to emit light at different wavelengths. *Id.* at 4:47–5:13. Rantala explains that to optimize and minimize power consumption in the pulse oximeter, control unit 18 changes at least one parameter, such as the pulse width, pulse repetition rate, and pulse amplitude, of the duty cycle of the pulse train driving the LEDs. *Id.* at 5:13–36. Exemplary pulse trains generated by the control unit are shown in Rantala’s Figures 3a and 4a, reproduced below.

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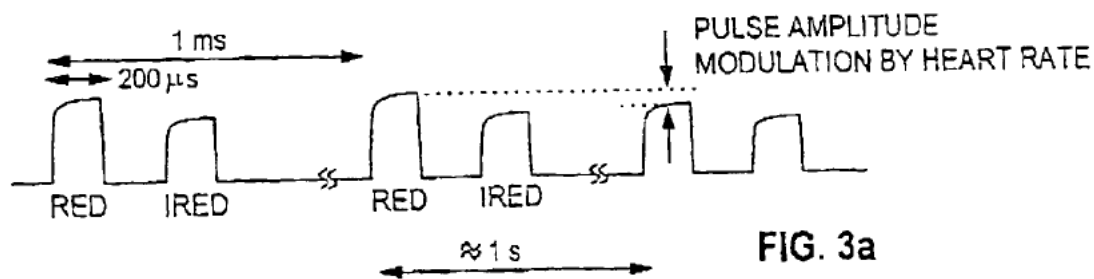


FIG. 3a

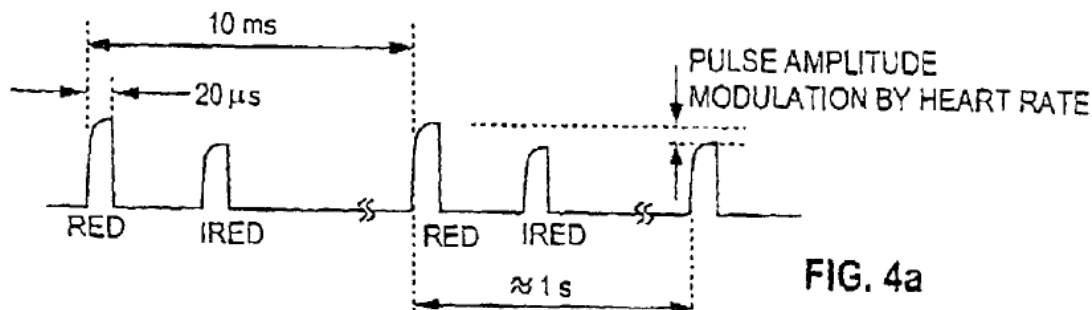


FIG. 4a

Figure 3a (top) “illustrates the timing sequence of the detector signal when a high duty cycle pulse sequence is used,” and Figure 4a (bottom) illustrates “the timing sequence of the detector signal when a low duty cycle pulse sequence is used.” *Id.* at 4:31–32, 38–39. Exemplary pulse trains generated by the control unit and depicted in Rantala’s Figures 3a and 4a show the pulse width of the pulse train in Figure 4a being narrower than the pulse width of the pulse train in Figure 3a. *Id.* at 6:20–56.

## 2. Dependent Claim 12

Claim 12 additionally requires “the one or more processors are further configured to modulate a duty cycle of one or more of the one or more emitters, and wherein the modulation includes pulse width time slots and off time slots.” Ex. 1001, 46:11–14. Petitioner contends that it would have been obvious for a person of ordinary skill in the art to have modified the

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processors of Aizawa-Ohsaki-Goldsmith to modulate a duty cycle of one or more of the one or more emitters as taught by Sherman. Pet. 95–99.

The cited evidence supports Petitioner’s undisputed contention that Rantala’s device includes one or more processors are further configured to modulate a duty cycle of one or more of the one or more emitters, and wherein the modulation includes pulse width time slots and off time slots. Pet. 95–99; *see, e.g.*, Ex. 1022, 6:22–29 (“The power control scheme of the present invention uses a high duty cycle pulse train only when the desired signal-to-noise ratio cannot otherwise be reached, i.e. the situation of [Figures] 3a to 3d” or “in [Figures] 4a to 4d the pulse oximeter is a narrow pulse oximeter where the LEDs are activated as briefly as possible in order to save power.”). Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 64, 176–179.

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 12 would have been obvious over the cited combination of references.

*G. Obviousness over the Combined Teachings of Aizawa, Ohsaki, Goldsmith, and Ali*

Petitioner challenges the patentability of claims 1–10 and 13–30 based on the combination of Aizawa, Ohsaki, Goldsmith, and Ali. Pet. 9, 99–102. Ali is relied upon to teach limitation [1h] which reads: “an orientation of the user interface is configurable responsive to a user input.” Petitioner contends that remaining claim limitations [1a]–[1g] and [1i]–[1k] are unpatentable for the same reasons raised with respect to the challenge of claim 1 based on the combination of Aizawa, Ohsaki, and Goldsmith.



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Pet. 99 (“Prior art mappings and arguments for all claim features other than [1h] in Ground 4 are the same as in Ground 1.”).

### *1. Overview of Ali*

Ali is a U.S. patent titled “Universal/Upgrading Pulse Oximeter,” and discloses a portable pulse oximeter unit for measuring a patient’s oxygen saturation or other related physiological parameters. Ex. 1019, codes (54), (57). The portable unit includes a display configured to display an image that is “rotatable, either manually . . . or as a function of orientation.” *Id.* at code (57). Figures 8B and 8C of Ali are reproduced below.

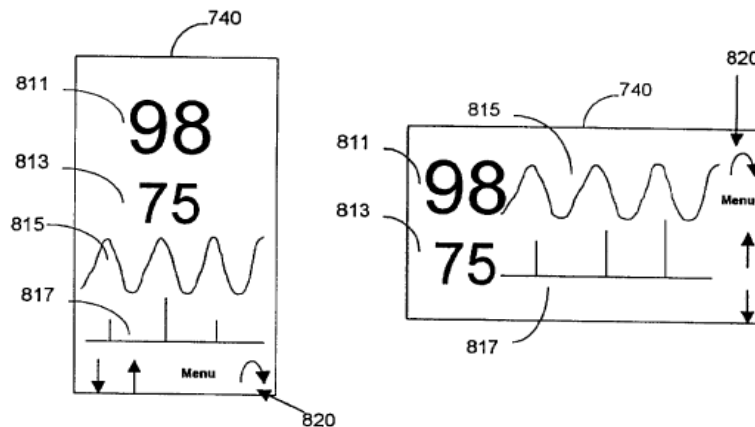


FIG. 8B

FIG. 8C

Figure 8B (left) depicts the display of the portable pulse oximeter in portrait mode, and Figure 8C (right) depicts the display of the portable oximeter in landscape mode. *Id.* at 11:62–64. The portrait mode and landscape mode are determined by a gravity-activated tilt sensor or a display mode key. *Id.* at 11:64–12:7.

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*2. Independent Claim 1 (Aizawa, Ohsaki, Goldsmith, and Ali)*

Petitioner presents undisputed contentions that claim 1 would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, and Ali. Pet. 99–102.

For this Ground, Patent Owner does not present any argument other than those we have already considered above with respect to the Ground based on Aizawa, Ohsaki, and Goldsmith. PO Resp. 52–53 (“Petitioner does not rely on Ali to fix the deficiencies in Ground 1. The Board should thus reject Ground 4 for the same reasons as Ground 1.”).

*i. [1a]–[1g] and [1i]–[1k]*

The cited evidence supports Petitioner’s contentions regarding these limitations. Pet. 41–54, 59–63.

Petitioner contends claim limitations [1a]–[1g] and [1i]–[1k] are unpatentable for the same reasons raised with respect to Petitioner’s challenge based on Aizawa, Ohsaki, and Goldsmith. Pet. 99. The ground based on Aizawa, Ohsaki, and Goldsmith is addressed *supra* at §§ (II)(D)(4)(i)–(xii). For the reasons discussed in these sections, Petitioner’s stated reasoning with respect to these limitations, and the basis for combining Aizawa, Ohsaki, and Goldsmith, is sufficiently supported, including by the testimony of Dr. Kenny.

*ii. “[h] an orientation of the user interface is configurable responsive to a user input”*

The cited evidence supports Petitioner’s undisputed contentions regarding this limitation and the rationale for combining Ali with Aizawa, Ohsaki, and Goldsmith. Pet. 99–102.

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As noted in our analysis above, Petitioner proposes integrating the pulse wave sensor of Aizawa (as modified by Ohsaki) into the watch controller device of Goldsmith, so that the modified sensor can transmit data to Goldsmith's touchscreen. Pet. 41. Goldsmith notes a problem in displaying images as a result of the display of a controller device and infusion pump having two different resolutions. Ex. 1011 ¶ 49.

Acknowledging the image display problem described in Goldsmith, Petitioner contends images displayed on the touchscreen user interface of the pulse wave sensor of Aizawa (as modified by Ohsaki and Goldsmith) "can be incorrect due to screen formatting, scaling, and resolution issues." Pet. 101 (citing Ex. 1011 ¶ 49). Goldsmith further discloses that its display is customizable with different backgrounds, fonts, wallpapers, or font sizes. Ex. 1011 ¶¶ 102, 104.

Figures 8B and 8C of Ali disclose a portable pulse oximeter that displays images, such as pulse rate data, in portrait mode or alternatively in landscape mode. Ex. 1019, 11:62–64, 12:8–12. Petitioner contends "to address problems in displaying graphs and text as described in Goldsmith, a POSITA would have included Ali's capability to select user interface orientation through a user input such that the user may have greater control over the display and enjoy an improved viewing experience." Pet. 101–102. Dr. Kenny testifies:

Implementing Ali's capability to select user interface orientation in [Aizawa, Ohsaki, and Goldsmith's physiological measurement device] would have been predictable at least because it would have involved incorporating a feature that was simple to implement and known in the industry. For instance, Ali concedes that its user interface orientation selection feature can easily be implemented through a software program for

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modifying the display of information. . . . Furthermore, this combination would have addressed a known issue in Goldsmith’s user interface, and would require nothing more than applying a known technique, as described by Ali.

Ex. 1003 ¶ 184; *also see* Pet. 102 (citing Ex. 1003).

Petitioner’s stated reasoning is sufficiently supported, including by the un rebutted testimony of Dr. Kenny.

*iii. Summary*

We have considered the evidence and arguments of record, including those directed to ground 1 addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 12 would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, and Ali for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

*3. Dependent Claims 2–10 and 13–30*

Petitioner also contends that claims 2–10 and 13–30 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 99–102. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 180–184.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 52–53 (“Petitioner does not rely on Ali to fix the deficiencies in

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Ground 1. The Board should thus reject Ground 4 for the same reasons as Ground 1.”).

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–10 and 13–30 would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, and Ali for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–10 and 13–30 would have been obvious over the cited combination of references.

*H. Obviousness over the Combined Teachings of Aizawa, Ohsaki, Goldsmith, Ali, and Sherman*

Petitioner presents undisputed contentions that claim 11 would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, Ali, and Sherman. Pet. 102–103.

Patent Owner does not present any argument for claim 11 other than those we have already considered above with respect to the Ground based on Aizawa, Ohsaki, and Goldsmith. PO Resp. 53 (“Grounds 5[–]6 only address dependent claims and do not fix the deficiencies in Ground 4. The Board should thus reject Grounds 5[–]6 for the same reasons as Ground 1.”).

For the reasons discussed above in § II.E, Petitioner identifies teachings in the prior art references that teach or suggest the limitations of claim 11, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny.

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Ex. 1003 ¶¶ 185–186. For the same reasons, and having considered the evidence and arguments of record, including those directed to claim 1 and addressed above, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 11 would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, Ali, and Sherman for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1013, 1:4–24; Ex. 1003 ¶¶ 171–174, 185–186.

*I. Obviousness over the Combined Teachings of Aizawa, Ohsaki, Goldsmith, Ali, and Rantala*

Petitioner presents undisputed contentions that claim 12 would have been obvious over the combined teachings of Aizawa, Ohsaki, Goldsmith, Ali, and Rantala. Pet. 102–103.

Patent Owner does not present any argument for claim 12 other than those we have already considered with respect to claim 1. PO Resp. 53 (“Grounds 5[–]6 only address dependent claims and do not fix the deficiencies in Ground 4. The Board should thus reject Grounds 5[–]6 for the same reasons as Ground 1.”).

For the reasons discussed above in § II.F, Petitioner identifies teachings in the prior art references that teach or suggest the limitations of claim 12, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 185–186. For the same reasons, and having considered the evidence and arguments of record, including those directed to claim 1 and addressed above, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 12 would have been obvious over

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the combined teachings of Aizawa, Ohsaki, Goldsmith, Ali, and Rantala for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1022, 6:22–29; Ex. 1003 ¶¶ 176–179, 185–186.

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### III. CONCLUSION

In summary:<sup>10</sup>

<b>Claims</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/ Basis</b>	<b>Claims Shown Unpatentable</b>	<b>Claims Not Shown Unpatentable</b>
1–10, 13–30	103	Aizawa, Ohsaki, Goldsmith	1–10, 13–30	
11	103	Aizawa, Ohsaki, Goldsmith, Sherman	11	
12	103	Aizawa, Ohsaki, Goldsmith, Rantala	12	
1–10, 13–30	103	Aizawa, Ohsaki, Goldsmith, Ali	1–10, 13–30	
11	103	Aizawa, Ohsaki, Goldsmith, Ali, Sherman	11	
12	103	Aizawa, Ohsaki, Goldsmith, Ali, Rantala	12	
<b>Overall Outcome</b>			1–30	

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<sup>10</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).



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ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–30 of the '564 patent have been shown to be unpatentable;

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC.,  
Petitioner,

v.

MASIMO CORPORATION,  
Patent Owner.

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Patent 10,702,194 B1

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Before JOSIAH C. COCKS, ROBERT L. KINDER, and  
AMANDA F. WIEKER, *Administrative Patent Judges*.

WIEKER, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

### *A. Background*

Apple Inc. (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–30 (“challenged claims”) of U.S. Patent No. 10,702,194 B1 (Ex. 1001, “the ’194 patent”). Paper 2 (“Pet.”). Masimo Corporation (“Patent Owner”) waived filing a preliminary response. Paper 6 (“PO Waiver”). We instituted an *inter partes* review of all challenged claims 1–30 on all grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 7 (“Inst. Dec.”).

After institution, Patent Owner filed a Response (Paper 15, “PO Resp.”) to the Petition, Petitioner filed a Reply (Paper 19, “Pet. Reply”), and Patent Owner filed a Corrected Sur-reply (Paper 28, “PO Sur-reply”). An oral hearing was held on February 9, 2022, and a transcript of the hearing is included in the record. Paper 34 (“Tr.”).

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–30 of the ’194 patent are unpatentable.

### *B. Related Matters*

The parties identify the following matters related to the ’194 patent: *Masimo Corporation v. Apple Inc.*, Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

*Apple Inc. v. Masimo Corporation*, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

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*Apple Inc. v. Masimo Corporation*, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

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*Apple Inc. v. Masimo Corporation*, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1); and

*Apple Inc. v. Masimo Corporation*, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1).

Pet. 91; Paper 3, 1–4.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the '194 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 3, 1–2.

### *C. The '194 Patent*

The '194 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on July 7, 2020, from U.S. Patent Application No. 16/829,536, filed March 25, 2020. Ex. 1001, codes (21), (22), (45), (54). The '194 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The '194 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:49–51. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:40–46, 3:8–9. The patient monitor includes a

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display and a network interface for communicating with a handheld computing device. *Id.* at 2:56–59.

Figure 1 of the '194 patent is reproduced below.

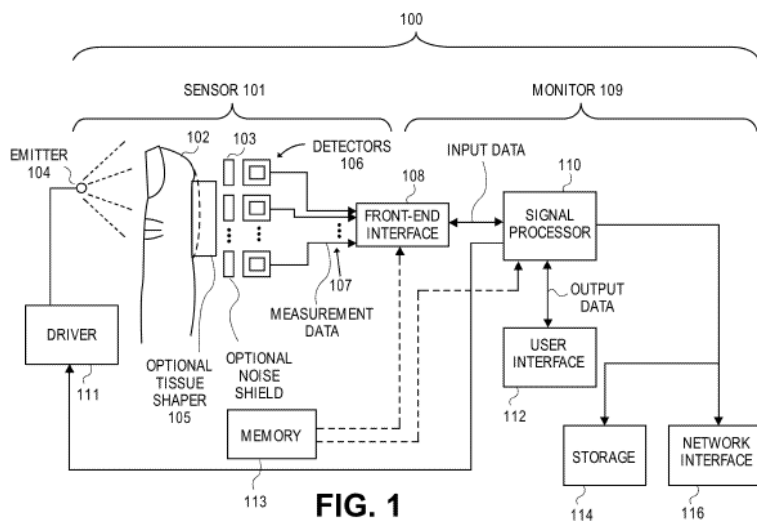


Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:56–67. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 12:1–5. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 14:11–16. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:16–19, 36–42. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:7–23.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:27–29. “[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors.” *Id.* at 15:32–35. User interface 112 presents

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the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:57–67. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 16:4–22.

The '194 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

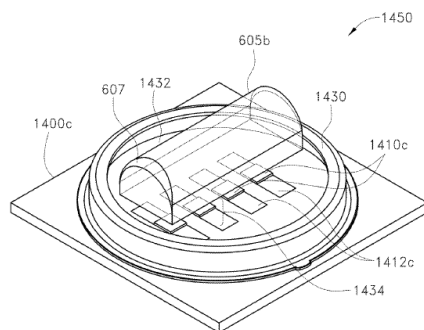
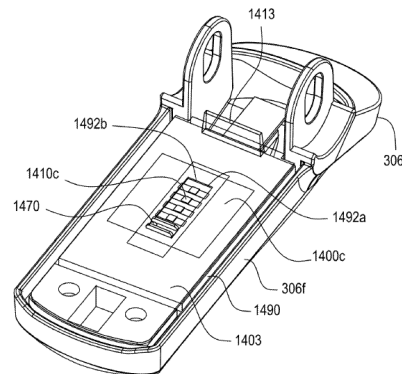
**FIG. 14D****FIG. 14F**

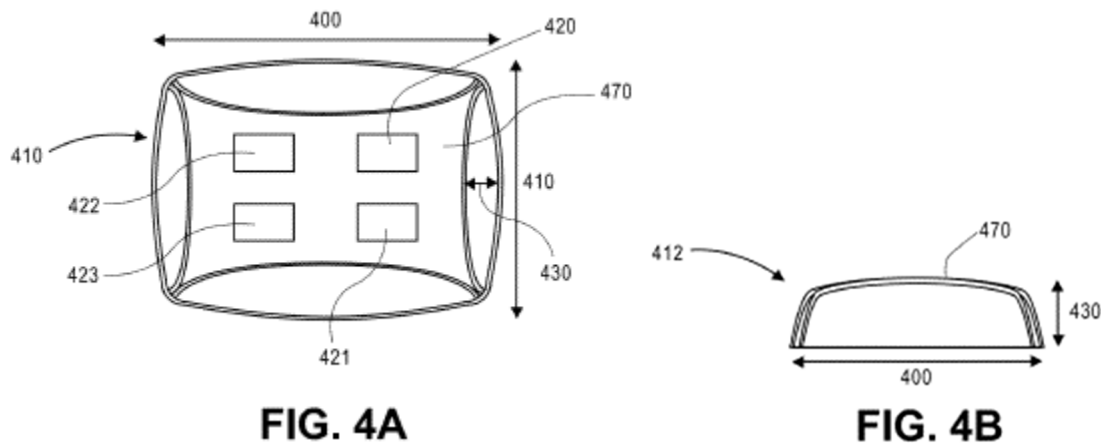
Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:54–57. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:51–54, 36:45–52. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:25–33. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:63–65.



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Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.



Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:30–36. “[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site.” *Id.* “For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site.” *Id.* at 23:53–55. The measurement site contact area may include windows 420–423 that “mimic or approximately mimic a configuration of, or even house, a plurality of detectors.” *Id.* at 23:61–24:8.

#### *D. Illustrative Claim*

Of the challenged claims, claims 1, 20, and 30 are independent. Claim 1 is illustrative and is reproduced below.

1. A physiological measurement system comprising:
  - [a] a physiological sensor device comprising:
    - [b] one or more emitters configured to emit light into tissue of a user;
    - [c] a first set of photodiodes, wherein:

[d] the first set of photodiodes comprises at least four photodiodes,

[e] the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream, and

[f] each of the photodiodes of the first set of photodiodes has a corresponding window that allows light to pass through to the photodiode;

[g] a second set of photodiodes, wherein:

[h] the second set of photodiodes comprises at least four photodiodes,

[i] the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream, and

[j] each of the photodiodes of the second set of photodiodes has a corresponding window that allows light to pass through to the photodiode;

[k] a wall that surrounds at least the first and second sets of photodiodes; and

[l] a cover comprising a protruding convex surface, wherein the protruding convex surface is above all of the photodiodes of the first and second sets of photodiodes, wherein at least a portion of the protruding convex surface is rigid, and wherein the cover is above the wall; and

[m] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises:

[n] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user;

[o] a touch-screen display configured to provide a user interface, wherein:

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[p] the user interface is configured to display indicia responsive to measurements of the physiological parameter, and

[q] an orientation of the user interface is configurable responsive to a user input; and

[r] a storage device configured to at least temporarily store at least the measurements of the physiological parameter.

Ex. 1001, 45:2–49 (bracketed identifiers [a]–[r] added). Independent claim 20 includes limitations substantially similar to limitations [a]–[j] and [l]–[m] of claim 1. *Id.* at 47:9–36. Independent claim 30 includes limitations similar to limitations [a]–[r] of claim 1, and also includes additional recitations. *Id.* at 48:38–50:21 (reciting also a “substrate” and certain “preprocessing electronics”).

#### *E. Applied References*

Petitioner relies upon the following references:

Beyer, Jr., U.S. Patent No. 7,031,728 B2, filed Sept. 21, 2004, issued Apr. 18, 2006 (Ex. 1019, “Beyer”);

Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1014, “Ohsaki”);

Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, “Aizawa”);

Y. Mendelson, et al., “Measurement Site and Photodetector Size Considerations in Optimizing Power Consumption of a Wearable Reflectance Pulse Oximeter,” Proceedings of the 25th IEEE EMBS Annual International Conference, 3016–3019 (2003) (Ex. 1024, “Mendelson-2003”); and

Y. Mendelson et al., “A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring,” Proceedings of the 28th IEEE

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EMBS Annual International Conference, 912–915 (2006) (Ex. 1010, “Mendelson-2006”).

Pet. 2. Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003), and the Second Declaration of Thomas W. Kenny (Ex. 1060). Patent Owner submits, *inter alia*, the Declaration of Vijay K. Madiseti, Ph.D. (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madiseti, including from this and other proceedings. *See* Exs. 1053–1054, 1056, 2006–2009, 2020, 2026, 2027.

#### *F. Asserted Grounds*

Petitioner asserts that claims 1–30 are unpatentable based upon the following grounds (Pet. 1–2):

<b>Claims Challenged</b>	<b>35 U.S.C. §</b>	<b>References/Basis</b>
1–18, 20, 22–30	103	Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006
19, 21	103	Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006, Beyer

## II. DISCUSSION

### *A. Claim Construction*

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 3. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 9–10.

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We agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

*B. Principles of Law*

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.<sup>1</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The

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<sup>1</sup> Patent Owner does not present objective evidence of non-obviousness.

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burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

*C. Level of Ordinary Skill in the Art*

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having “a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information.” Pet. 3 (citing Ex. 1003 ¶¶ 20–21). “Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline.” *Id.*

Patent Owner makes several observations regarding Petitioner’s identified level of skill in the art but, “[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner’s asserted level of skill.” PO Resp. 10 (citing Ex. 2004 ¶¶ 30–32).

We adopt Petitioner’s assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

*D. Obviousness over the Combined Teachings of Aizawa, Mendelson-2003, Ohsaki, and Mendelson-2006*

Petitioner contends that claims 1–18, 20, and 22–30 of the ’194 patent would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Mendelson-2006. Pet. 12–72.

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### 1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled “Pulse Wave Sensor and Pulse Rate Detector,” and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient’s artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

F I G . 1 ( a )

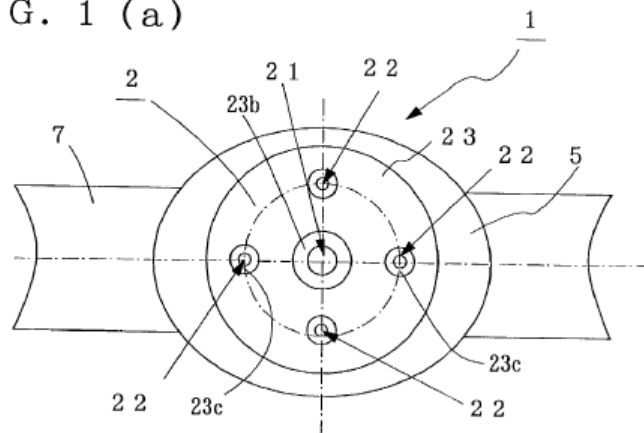


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode (“LED”) 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, “to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased.” *Id.* ¶ 32, Fig. 4(a). “The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22.” *Id.* ¶ 33.

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Figure 1(b) of Aizawa is reproduced below.

F I G . 1 ( b )

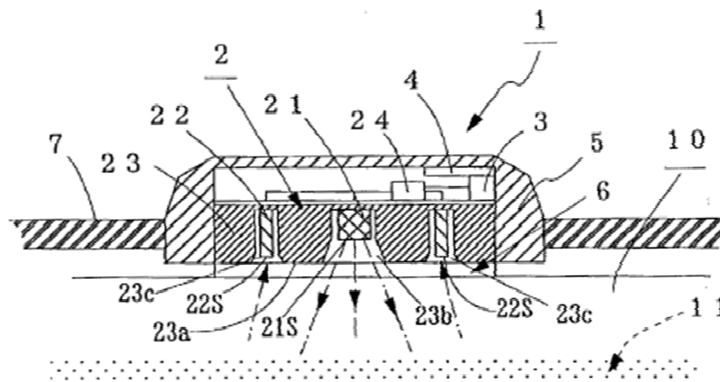


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* ¶ 23. Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an “unshown display.” *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.* ¶ 23.

Aizawa discloses that LED 21 and photodetectors 22 “are stored in cavities 23b and 23c formed in the detection face 23a” of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a “is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a.” *Id.* ¶ 24. Aizawa discloses that “a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side).” *Id.* ¶ 26. Furthermore, “the above belt 7 is fastened such that the acrylic



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transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.”

*Id.* ¶¶ 26, 34.

## 2. Overview of Mendelson-2003 (Ex. 1024)

Mendelson-2003 is a journal article titled “Measurement Site and Photodetector Size Considerations in Optimizing Power Consumption of a Wearable Reflectance Pulse Oximeter,” which discusses a pulse oximeter sensor in which “battery longevity could be extended considerably by employing a wide annularly shaped photodetector ring configuration and performing SpO<sub>2</sub> measurements from the forehead region.” Ex. 1024, 3016.<sup>2</sup>

Mendelson-2003 explains that pulse oximetry uses sensors to monitor oxygen saturation (SpO<sub>2</sub>), where the sensor typically includes light emitting diodes (LED) and a silicon photodetector (PD). *Id.* According to Mendelson-2003, when designing a pulse oximeter, it is important to offer “low power management without compromising signal quality.” *Id.* at 3017. “However, high brightness LEDs commonly used in pulse oximeters require[] relatively high current pulses, typically in the range between 100–200mA. Thus, minimizing the drive currents supplied to the LEDs would contribute considerably toward the overall power saving in the design of a more efficient pulse oximeter.” To achieve this goal, Mendelson-2003 discusses previous studies in which

the driving currents supplied to the LEDs . . . could be lowered significantly without compromising the quality of the

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<sup>2</sup> Petitioner cites to the native page numbers appearing at the top of Exhibit 1024, rather than the added page numbering at the bottom of the pages. We follow Petitioner’s numbering scheme.

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[photoplethysmographic signal] by increasing the overall size of the PD . . . . Hence, by maximizing the light collected by the sensor, a very low power-consuming sensor could be developed, thereby extending the overall battery life of a pulse oximeter intended for telemedicine applications.

*Id.*

Mendelson-2003 discloses the prototype of such a sensor in Figure 1, which is reproduced below, and served as the basis for the studies evaluated in Mendelson-2003.

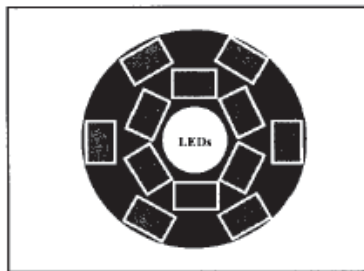


Figure 1 of Mendelson-2003 depicts a sensor configuration showing the relative positions of its PDs and LEDs. *Id.* As shown in Figure 1, “six PDs were positioned in a close inner-ring configuration at a radial distance of 6.0mm from the LEDs. The second set of six PDs spaced equally along an outer-ring, separated from the LEDs by a radius of 10.0mm.” *Id.*

Mendelson-2003 also explains that “[e]ach cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” *Id.*

Mendelson-2003 reports the results of the studies as follows:

Despite the noticeable differences between the PPG signals measured from the wrist and forehead, the data plotted in Fig. 3 also revealed that considerable stronger PPGs could be obtained by widening the active area of the PD which helps to collect a bigger proportion of backscattered light intensity. The additional increase, however, depends on the area and relative position of the PD with respect to the LEDs. For example,

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utilizing the outer-ring configuration, the overall increase in the average amplitudes of the R and IR PPGs measured from the forehead region was 23% and 40%, respectively. Similarly, the same increase in PD area produced an increase in the PPG signals measured from the wrist, but with a proportional higher increase of 42% and 73%.

*Id.* at 3019.

### 3. Overview of Ohsaki (Ex. 1014)

Ohsaki is a U.S. patent application publication titled “Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User’s Wrist,” and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1014, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

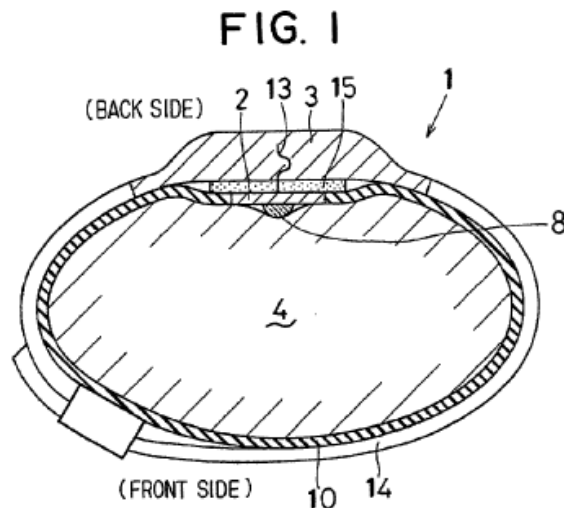


Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user’s wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

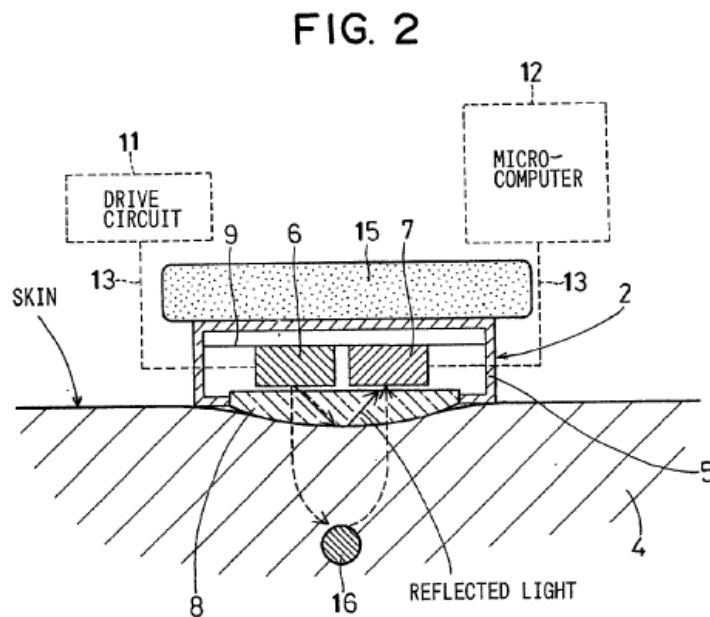


Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

“[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. “[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user’s skin,” preventing detecting element 2 from slipping off the detecting position of the user’s wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses “variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the

user's skin.” *Id.* Additionally, the convex surface prevents penetration by “noise such as disturbance light from the outside.” *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* “The monitor display shows the calculated pulse rate.” *Id.*

#### 4. Mendelson-2006 (Ex. 1016)

Mendelson-2006 is a journal article titled “A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring,” and discloses a wireless wearable pulse oximeter connected to a personal digital assistant (“PDA”). Ex. 1016, 1.

Figure 1 of Mendelson-2006 is reproduced below.



Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

Figure 2 of Mendelson-2006 is reproduced below.

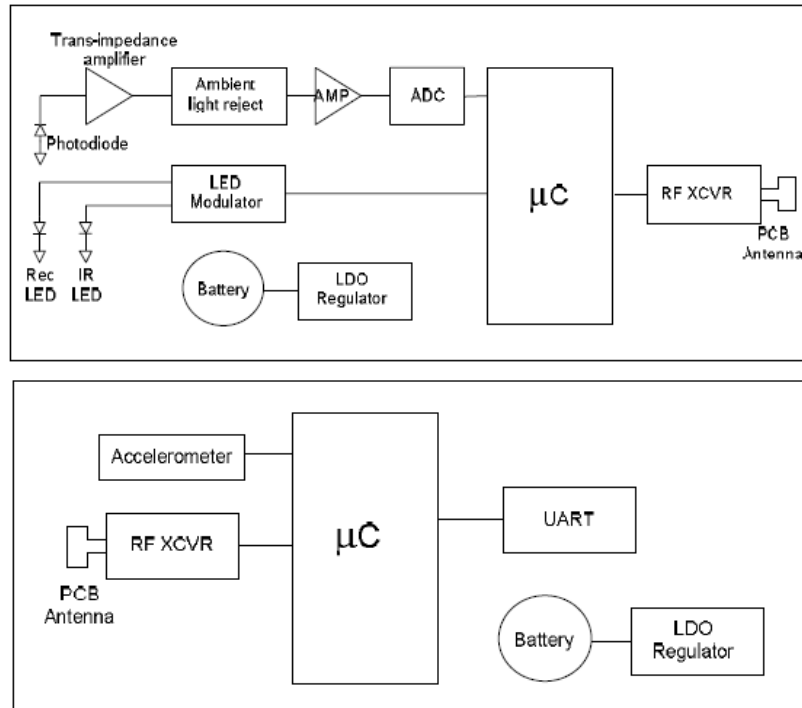


Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode (“LED”), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses “the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication” and “has sufficient computational resources.” *Id.* at 3. Mendelson-2006 further discloses that

[t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

*Id.*

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.



Figure 3 illustrates a sample PDA and its graphical user interface (“GUI”). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* “The GUI was configured to present the input and output information to the user and allows easy activation of various functions.” *Id.* “The GUI also displays the subject’s vital signs, activity

level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device.” *Id.* For example, the GUI displays numerical oxygen saturation (“SpO<sub>2</sub>”) and heart rate (“HR”) values. *Id.*

### 5. *Independent Claim 1*

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006. Pet. 30–54. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties’ contentions and then provide our analysis.

#### *i. “A physiological measurement system comprising”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses the subject matter of the preamble.<sup>3</sup> Pet. 30; *see, e.g.*, Ex. 1006 ¶ 2 (disclosing “a pulse wave sensor for detecting the pulse wave of a subject”).

#### *ii. “[a] a physiological sensor device comprising”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses a physiological sensor device including a pulse rate detector. Pet. 30–31; *see, e.g.*, Ex. 1006 ¶ 23 (pulse wave sensor 2), Figs. 1(a)–(b).

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<sup>3</sup> Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble’s subject matter is satisfied by the prior art.



- iii. “[b] one or more emitters configured to emit light into tissue of a user”

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses LED 21 that emits light into a user’s tissue. Pet. 31; see, e.g., Ex. 1006 ¶ 23 (“LED 21 . . . for emitting light having a wavelength of a near infrared range”), 27 (explaining that light is emitted toward the wrist), Fig. 1(b) (depicting emitter 21 facing user tissue 10).

- iv. “[c] a first set of photodiodes, wherein: [d] the first set of photodiodes comprises at least four photodiodes”  
and  
“[g] a second set of photodiodes, wherein: [h] the second set of photodiodes comprises at least four photodiodes”

#### Petitioner’s Undisputed Contentions

Petitioner contends that Aizawa discloses a first set of four photodiodes that are circularly arranged around a central emitter. Pet. 16 (citing, e.g., Ex. 1006 ¶ 23). Petitioner also contends that, in one embodiment, Aizawa discloses that eight or more detectors may be used to improve detection efficiency, but does not expressly teach a “second set of photodiodes,” as claimed. *Id.* at 17 (citing, e.g., Ex. 1006, Fig. 4(a)); see also Ex. 1003 ¶¶ 66–67.

Patent Owner does not dispute these contentions, and we agree with Petitioner. Aizawa discloses a set of “four phototransistors 22” that are disposed in a single ring around central emitter 21. Ex. 1006 ¶ 23, Figs. 1(a)–1(b). Aizawa also discloses that “the number of the photodetectors 22 may be increased” to further improve detection efficiency,

and depicts in Figure 4(a) an embodiment where eight photodetectors 22 are disposed in a single ring around central emitter 21. *Id.* ¶ 32.

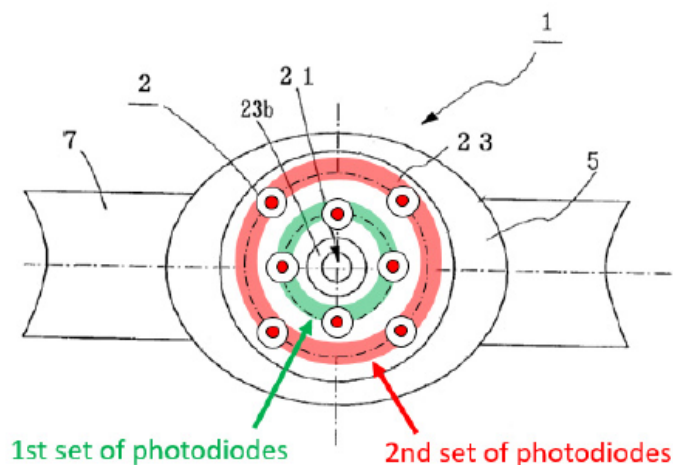
Also, according to Petitioner, Mendelson-2003 teaches a sensor that uses two rings of photodiodes, which improve light collection efficiency, permit use of lower brightness LEDs, and reduce power consumption. Pet. 18–19; *see also* Ex. 1003 ¶¶ 69–70.

Patent Owner does not dispute these contentions regarding what Mendelson-2003 discloses, and we agree with Petitioner. Mendelson-2003 teaches an experimental sensor in which “six PDs [(photodetectors)] were positioned in a close inner-ring configuration . . . [and a] second set of six PDs [were] spaced equally along an outer-ring.” Ex. 1024, 3017, Fig. 1 (depicting a prototype sensor with a near ring of photodetectors and a far ring of photodetectors). Based on experiments using the dual-ring sensor, as compared to sensors using only a near ring or only a far ring, Mendelson-2003 states that “considerabl[y] stronger PPGs [photoplethysmographic signals] could be obtained by widening the active area of the PD which helps to collect a bigger proportion of backscattered light intensity.” *Id.* at 3019, Fig. 3. Mendelson-2003 also states that, “by combining both PD sets to simulate a single large PD area, it is possible to further reduce the driving currents of the LEDs without compromising the amplitude or quality of the detected PPGs.” *Id.* at 3019, Fig. 4. Finally, Mendelson-2003 teaches that estimated battery life for the dual-ring sensor, as compared to sensors using only a near ring or only a far ring, “could be extended considerably.” *Id.* at 3019, Table 1 (battery life of 52.5 days for the dual-ring sensor, compared to 45.8 and 20.3 days for the near ring or far ring sensors, respectively).

Petitioner’s Disputed Contentions

In view of these teachings, Petitioner contends that a person of ordinary skill in the art would have found it obvious to modify Aizawa to include an additional ring of detectors, as taught by Mendelson-2003, (i.e., a “second set”) to “advance[e] Aizawa’s goal of improving detection efficiency through increased power savings.” Pet. 17–18 (citing, e.g., Ex. 1003 ¶ 68), 32–33 (citing, e.g., Ex. 1003 ¶¶ 90–91), 41–42 (citing, e.g., Ex. 1003 ¶¶ 100–101). According to Petitioner, “by using Mendelson-2003’s power-saving (and thus efficiency-enhancing) PD configuration, the power consumption of a wrist-based pulse sensing device as in Aizawa can be reduced through use of a less bright and, hence, lower power-consuming LED.” *Id.* at 19–20 (citing, e.g., Ex. 1003 ¶ 71).

Petitioner provides “[a]n example implementation of adding an additional ring of detectors to Aizawa, as per Mendelson-2003,” which is reproduced below.



Pet. 20 (citing, e.g., Ex. 1003 ¶ 72). Petitioner’s modified and annotated figure depicts Aizawa’s sensor with Aizawa’s first set of photodiodes (depicted as connected by a green ring) and modified to include a second set of photodiodes as taught by Mendelson-2003 (depicted as connected by a red ring). Pet. 20–21, 33, 41. Petitioner contends this would have been the

use of a known solution to improve similar systems in the same way, which “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor,” especially where Aizawa itself discloses adding extra detectors to improve light collection efficiency. *Id.* at 21–22 (citing, e.g., Ex. 1003 ¶ 74).

#### Patent Owner’s Arguments

Patent Owner’s arguments address limitations [c]–[e] and [g]–[i] together. *See* PO Resp. 55–66. As such, Patent Owner’s arguments, the parties’ Reply and Sur-reply briefing, and our analyses, are presented below in connection with limitations [e] and [i]. *See infra* § II.D.5.v.

- v. *“[e] the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream”  
and  
“[i] the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream”*

#### Petitioner’s Undisputed Contentions

Petitioner contends that a signal stream is sent from Aizawa’s set of photodetectors 23 to drive detection circuit 24, which amplifies the outputs of the photodetectors. Pet. 16 (citing, e.g., Ex. 1006 ¶ 23; Ex. 1003 ¶ 66).

Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that “drive detection circuit 24 [is] for detecting a pulse wave by amplifying the outputs of the photodetectors 22.” Ex. 1006 ¶ 23.

Petitioner additionally contends that Mendelson-2003 teaches that each set of photodiodes, i.e., its near ring and far ring, is wired in parallel,

thereby providing a distinct signal stream for each ring. Pet. 18, 34–35 (citing, e.g., Ex. 1024, 3017).

Patent Owner does not dispute this contention regarding what Mendelson-2003 discloses, and we agree with Petitioner. Mendelson-2003 teaches that “[e]ach cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” Ex. 1024, 3017.

Petitioner’s Disputed Contentions

In view of these teachings, Petitioner contends that a person of ordinary skill in the art “would have recognized and/or found it obvious that the first set of photodiodes [in the modified system of Aizawa and Mendelson-2003, *see supra* § II.D.5.iv] are connected to one another in parallel to provide a first signal stream in the manner claimed,” and “the photodiodes in the second/outer ring (i.e., second set of photodiodes) . . . are connected to one another in parallel to provide a second signal stream,” as taught by Mendelson-2003. Pet. 33–34, 42 (citing, e.g., Ex. 1003 ¶¶ 92–97, 102), 21 (citing, e.g., Ex. 1003 ¶ 73). Petitioner contends this “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor.” *Id.* at 21–22 (citing, e.g., Ex. 1003 ¶ 74).

According to Petitioner, this arrangement would have provided known benefits. Pet. 34–38. For example, Petitioner contends that a person of ordinary skill in the art “would have known that connecting multiple photodiodes together in parallel allows the current generated by the multiple photodiodes in [each] set/ring to be added to one another, thereby resulting in a larger total current akin to what would be generated from a single, large

detector.” *Id.* at 34. According to Petitioner, this was “a routine and conventional design choice.” *Id.* at 35. Further, “monitoring each signal stream (from each ring of detectors) separately allows the system to determine when the sensor device is so severely located that its position should be adjusted,” and can help detect motion artifacts. *Id.* at 35–36 (citing Ex. 1003 ¶ 95).

Petitioner also argues that a person of skill in the art would have known that “the photodiodes in the far ring (i.e., second set of photodiodes) would receive reflected light having a lower intensity than that received by the photodiodes in the near ring (i.e., first set of photodiodes) and would have been motivated and found it obvious to account for this discrepancy,” e.g., by “keep[ing] each ring separately wired and connected to its own amplifier . . . to thereby keep the magnitude of the current signals provided by each ring approximately the same before being combined and transmitted to the arithmetic circuit 3.” *Id.* at 36–38 (citing Ex. 1003 ¶¶ 96–97); *id.* at 42 (citing Ex. 1003 ¶ 102).

#### Patent Owner’s Arguments

Patent Owner disputes Petitioner’s contentions that it would have been obvious (1) to modify Aizawa to include a second set of at least four photodiodes, and (2) to wire the photodiodes of the first set in parallel to provide a first signal stream and to wire the photodiodes of the second set in parallel to provide a second signal stream. PO Resp. 55–66; PO Sur-reply 24–30.

First, Patent Owner argues this proposed modification changes Aizawa’s principle of operation. Specifically, Patent Owner claims that “Aizawa’s approach monitors different individual detector signals and

calculates pulse rate based on each individual photodetector signal” and, in contrast to the proposed modification, “does not measure aggregated signals from detectors connected in parallel.” PO Resp. 57 (citing Ex. 1006 ¶¶ 7, 19, 23, 27–29, 32, 36; Ex. 2004 ¶ 102; Ex. 2026, 76:13–22, 79:22–80:3). According to Patent Owner, the proposed modification “eliminates Aizawa’s core feature—the ability to monitor pulse using the output of each individual detector, which Aizawa indicates avoids displacement problems.” *Id.* at 58–59 (citing, e.g., Ex. 2004 ¶¶ 104–105).

Second, Patent Owner argues this proposed modification would have resulted in increased power consumption. *Id.* at 59. According to Patent Owner, Mendelson-2003 states that its power savings is caused by “increasing the ***number of detectors*** and thus the detector area, not the two-ring structure.” *Id.* at 59–60 (citing Ex. 1024, 2; Ex. 2004 ¶ 106).

Moreover, Patent Owner argues that Aizawa already discloses a way to improve detection efficiency—by including eight detectors in a single ring. *Id.* at 60 (citing Ex. 1006 ¶ 32, Fig. 4A; Ex. 2004 ¶ 107). In light of this teaching, Patent Owner argues that adding a second ring is unfounded and unnecessary, especially where the second ring of detectors “would receive substantially lower light intensity requiring greater power consumption to utilize than additional detectors added to the ‘inner’ ring.” *Id.* at 60–62 (citing, e.g., Ex. 2004 ¶¶ 108–109; Ex. 2026, 55:7–17, 56:6–16, 59:14–60:7, 100:6–101,6, 102:5–17, 112:3–16). “Petitioner never explains why, given these straightforward options to increase signal strength, a [person of ordinary skill in the art] would instead add an entire new circle of detectors farther from the emitter.” *Id.* at 62.

Third, Patent Owner argues that Mendelson-2003 provides only an experimental detector configuration, which would fail to provide the alleged benefits. Specifically, Patent Owner argues that Mendelson-2003 “uses its particular configuration for specific experiments comparing light intensity and LED drive currents for detectors arranged different distances from central emitters,” and “teaches no benefits for this arrangement in practice.” *Id.* at 62–63 (citing Ex. 1024, 4; Ex. 2004 ¶¶ 111–112). To the contrary, Patent Owner alleges that Mendelson-2003 actually prefers a single detector ring that outputs a single signal stream: “Mendelson 2003 explains it ‘combin[ed] both PD sets to simulate *a single* large PD area,’ and notes ‘battery longevity could be extended considerably by employing *a* wide annular PD,’ which has a single signal stream—not two different signal streams from two different parallel-connected rings.” *Id.* at 63 (citing, e.g., Ex. 2026. 87:8–88:1, 91:15–92:7).<sup>4</sup> Thus, according to Patent Owner, even if a skilled artisan would have added a second ring of detectors to Aizawa, they “would not have kept the first and second ring of detectors *separate* or separately amplified the aggregated signals”; instead, they would have

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<sup>4</sup> Patent Owner also criticizes the Petition’s discussion of Exhibit 1025, U.S. Patent No. 6,801,799 (“Mendelson ’799”), which is not included in Petitioner’s identification of the asserted ground of unpatentability. PO Resp. 63–65; PO Sur-reply 29–30. We discern no error in Petitioner’s identification of Mendelson ’799. The nature of Petitioner’s reliance on Mendelson ’799 in support of this ground is explained clearly in the Petition, even if Mendelson ’799 is not listed as an additional reference in the identification of the ground. Thus, the Petition complies with 35 U.S.C. § 312(a)(3) (stating an IPR petition must “identif[y], in writing and with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge”).



“combin[ed] both PD sets to simulate *a single* large PD area,” where “battery longevity could be extended considerably by employing a wide annular PD.” *Id.* at 66 (quoting Ex. 1024, 4; citing Ex. 2004 ¶ 116).

Finally, Patent Owner argues that the proposed combination “introduces signal processing problems requiring a *further* redesign for Aizawa’s sensor” to include a second amplifier to account for signals of different strengths between the near and far rings. *Id.* at 65–66 (citing Ex. 2004 ¶ 115). Patent Owner alleges this demonstrates that a skilled artisan would not have added a second ring of detectors, as proposed, but instead would have increased the number of detectors in Aizawa’s single ring. *Id.* at 66.

#### Petitioner’s Reply

Petitioner replies that Patent Owner mischaracterizes Aizawa’s principle of operation. Pet. Reply 32–34. Specifically, Petitioner contends that Aizawa’s detector ring is connected in parallel, or at least that a person of ordinary skill in the art would have recognized that parallel connection would have been a known implementation detail, which allows a signal to be detected even if one of the multiple sensors is displaced on the user. *Id.* at 33 (citing Ex. 1003 ¶¶ 93–94; Ex. 1060 ¶ 62; Ex. 2026, 72:3–9). Moreover, Petitioner argues that Aizawa lacks any disclosure of individually monitoring signals from each photodetector. *Id.* at 34.

Petitioner reiterates its position that adding a second ring would collect a bigger portion of backscattered light, and would have motivated the proposed combination. *Id.* at 35 (citing, e.g., Ex. 1060 ¶¶ 65–66). Petitioner also disputes that such a modification would increase power, noting that it is the emitters, not the detectors, that consume most power in the system. *Id.*

at 36 (citing, e.g., Ex. 1060 ¶ 67). Moreover, Petitioner contends that by widening the detection area with a second ring, the system would capture additional light which would allow a lower brightness, and lower power, emitter to be used. *Id.*

Petitioner disputes Patent Owner's characterization of Mendelson-2003 as purely experimental, and alleges that Mendelson-2003 makes clear that employing two rings outputting two signal streams is equivalent to employing a wider single ring of detectors, and provides associated benefits. *Id.* at 36–38 (citing, e.g., Ex. 1060 ¶ 70).

#### Patent Owner's Sur-reply

Patent Owner reiterates its position that Aizawa concerns individual monitoring, which Patent Owner alleges is a “key feature of Aizawa's sensor,” in order to avoid problems associated with sensor displacement. PO Sur-reply 24–26. Patent Owner also reiterates its positions that the proposed modified sensor would consume more power, and that Aizawa's disclosed embodiment with eight detectors in a single ring would have been preferred. *Id.* at 26–29.

#### Analysis

We have considered the parties' arguments and cited evidence, and we are persuaded by Petitioner's contentions. As discussed above, Aizawa discloses a sensor with a first set of four phototransistors 22 as claimed, which are disposed in a single ring around central emitter 21. Ex. 1006 ¶ 23, Figs. 1(a)–1(b). Mendelson-2003 teaches a sensor with a dual-ring configuration, where a first inner ring includes six photodetectors, and a second outer ring includes an additional six photodetectors. Ex. 1024, 3017, Fig. 1. Mendelson-2003 also states that by using this dual-ring

configuration to simulate a wide photodetector area, stronger signals could be obtained, drive currents could be reduced, and battery life could be extended. *Id.* at 3019, Fig. 3, Fig. 4.

In light of these explicit teachings, we are persuaded by Petitioner’s contention that a person of ordinary skill in the art would have found it obvious to include a second set of detectors in Aizawa’s sensor, as taught by Mendelson-2003, to realize the benefits taught by Mendelson-2003, i.e., stronger signals with reduced power consumption. Pet. 17–18, 41–42. We credit Dr. Kenny’s testimony that this would have been the use of a known solution—a sensor with dual detector rings as taught by Mendelson-2003—to improve similar systems—Aizawa’s sensor with one detector ring—in the same way, which “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor,” especially where Aizawa itself discloses adding extra detectors to improve light collection efficiency. Ex. 1003 ¶ 74.

We also credit Dr. Kenny’s testimony that, as taught by Mendelson-2003, it would have been obvious to connect the photodetectors of each set in parallel to provide first and second signal streams, respectively, and that this would have led to predictable results. Ex. 1003 ¶ 74 (predictable), 93–94 (first set), 102 (second set). Indeed, the two rings taught by Mendelson-2003 are disclosed as being “wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” Ex. 1024, 3017. Dr. Kenny explains numerous advantages associated the parallel connections taught by Mendelson-2003, such as monitoring for displacement, accounting for motion artifacts, and

compensating for the relative decrease in light that reaches the outer ring, which cannot be achieved with a single signal stream. Ex. 1003 ¶¶ 95–97.

We have considered Patent Owner’s arguments but find them to be misplaced. First, we do not agree that Aizawa discloses the ability to individually monitor individual detectors as a “key feature” (PO Resp. 56; PO Sur-reply 25) of its sensor. We discern no persuasive support for this position in Aizawa. Aizawa does not discuss individual monitoring at all, at least not clearly, and does not discuss individual monitoring as a solution to sensor displacement. Rather, Aizawa explains that its sensor includes four photodetectors 22 and that “reflected light is detected by the plurality of photodetectors 22.” Ex. 1006 ¶¶ 23, 27. Aizawa also explains that its sensor includes a “drive detection circuit for detecting a pulse wave by amplifying the outputs of the photodetectors 22.” *Id.* ¶ 23. These disclosures indicate that Aizawa does not monitor each photodetector 22 individually to ascertain the pulse wave but, rather, utilizes “the outputs” of *all* of the photodetectors together.

This understanding is consistent with Aizawa’s disclosure of sensor displacement. As Patent Owner correctly notes, Aizawa recognizes a problem with sensor displacement, in which “no output signal can be obtained” if the sensor’s detectors are placed away from an artery. *Id.* ¶ 7. Aizawa solves this problem by avoiding a “linear[]” detector arrangement, such that “[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately.” *Id.* ¶ 9. Indeed, Aizawa is clear that, in its preferred embodiment, it is the disposition of photodetectors 22 in “a circle concentric to the light emitting diode 21” that enables accurate

pulse detection even when the sensor is dislocated. *Id.* ¶ 27. Aizawa does not discuss individual monitoring in relation to sensor dislocation.

We have examined Patent Owner’s alleged support for the importance of individual monitoring and find it unavailing. *See, e.g.*, PO Resp. 57 (citing Ex. 1006 ¶¶ 7, 19, 23, 27–29, 32, 36; Ex. 2004 ¶ 102; Ex. 2026, 76:13–22, 79:22–80:3). Patent Owner identifies Figure 3, which depicts a “diagram of a pulse wave which is the output of *a photodetector*.” Ex. 1006 ¶¶ 19 (emphasis added), 28 (“the above photodetector 22”). Patent Owner seems to place importance on the use of the article “a” or “the” photodetector, in the singular. PO Resp. 57; PO Sur-reply 24. However, we discern no significance in the singular use. In discussing this Figure, Aizawa does not discuss monitoring an individual photodetector, or describe that as a “key feature”; instead, Aizawa explains that drive detection circuit 24 amplifies the detected pulse wave and transmits it to arithmetic circuit 3, which compares it to a threshold value to calculate a pulse rate. Ex. 1006 ¶ 28. We discern that this discussion of how the circuits process a signal from “a” (or “the”) photodetector is merely exemplary of the process; Patent Owner has not pointed to any persuasive support for its position that this somehow indicates a “key feature” of Aizawa is individual monitoring. As noted above, Aizawa plainly discloses that it is the signals from *the plurality* of photodetectors that are used to determine a pulse wave. *Id.* ¶¶ 23, 27. Nothing in Figure 3 or paragraph 28 clearly contradicts that disclosure.

We have considered the cited testimony of Dr. Madisetti, which Patent Owner relies upon as support for its position, but we find it unavailing as well. Dr. Madisetti’s testimony includes the same citations presented by Patent Owner, none of which demonstrates individual

monitoring. Ex. 2004 ¶ 102. Thus, we determine this testimony to be conclusory and entitled to little weight.

We do recognize, as did Dr. Kenny during his deposition, that Aizawa does not provide extensive discussion of the algorithms through which Aizawa determines a pulse wave. *See, e.g.*, Ex. 2026, 80:8–18 (“It doesn’t describe the algorithm in detail. It just says amplifies the signals from the detectors and then performs whatever function takes place inside the arithmetic circuit which I think computes the number of times the signal crosses the threshold value to calculate the pulse rate, but there’s not a clearly described precise algorithm for what goes on. It’s left for one of ordinary skill in the art to process the waveforms and, and count the crossings of the threshold and determine the pulse rate.”). Nonetheless, we decline Patent Owner’s invitation to import into Aizawa’s disclosure a “key feature” of individual monitoring that is not identified by Aizawa with any reasonable clarity. Again, as noted above, Dr. Madisetti provides no further support for the conclusory position advanced by Patent Owner.

By contrast, we credit Dr. Kenny’s testimony, which is consistent with Aizawa’s express disclosure of detecting a pulse wave from “the plurality of photodetectors” (Ex. 1006 ¶ 27), that:

connecting multiple photodetectors together in parallel allows the current generated by the multiple photodetectors to be added to one another, which would subsequently ensure that even if one of multiple sensors connected in parallel were to be displaced so as to receive no signal, the fact that all the sensors are connected in parallel such that their signals are summed means that a signal will still be detected, in accordance with Aizawa’s objective.

Ex. 1060 ¶ 62. Moreover, we agree with Dr. Kenny that “there is no disclosure anywhere in Aizawa to suggest that it is even capable of

somehow monitoring the signals of each photodetector, and there is certainly no need to do so if its sensors are connected in parallel.” *Id.* Thus, considering the express disclosure of Aizawa and the competing testimony of the parties’ experts, we credit that of Dr. Kenny.

Patent Owner’s second argument—that the proposed modification would have resulted in increased power consumption—is plainly contradicted by Mendelson-2003’s disclosure. Table 1 of Mendelson-2003 is reproduced below.

**Table 1.** Comparison of estimated battery life for different PD configurations. Values based on forehead measurements for a typical 220mAh coin size battery.

PD CONFIGURATION	BATTERY LIFE [Days]
Near	45.8
Far	20.3
Near+Far	52.5

Table 1 includes three rows, each associating a different photodetector configuration with an estimated battery life. Ex. 1024, 3019. The table indicates that a configuration consisting of only a near ring of photodetectors results in 45.8 days of battery life; a configuration consisting of only a far ring of photodetectors results in 20.3 days of battery life; and a configuration consisting of both a near ring and a far ring of photodetectors results in 52.5 days of battery life. *Id.* In describing this table, Mendelson-2003 states, “the considerable differences in the estimated power consumptions clearly points out the practical advantage gained by using a reflection sensor comprising a large ring-shaped PD area to perform SpO<sub>2</sub> measurements,” which in this case, was realized by the combination of a near and far ring of detectors, akin to the modification proposed by Petitioner. *Id.* Thus, we do not agree with Patent Owner’s argument that power consumption would

increase if a second ring of detectors were added to Aizawa's sensor; Mendelson-2003 plainly suggests the opposite and supports Petitioner's contention that the proposed modification would result in a power savings over a single ring.

We also do not agree with the argument that a person of ordinary skill in the art would not make the proposed modification because Aizawa already discloses a way to improve detection efficiency, e.g., by including more detectors in a single ring. PO Resp. 60 (citing Ex. 1006 ¶ 32, Fig. 4A; Ex. 2004 ¶ 107). Aizawa explains that the photodetector arrangement of its single-ring preferred embodiment "is not limited" and suggests, "[f]or example," that "the number of photodetectors 22 may be increased." Ex. 1006 ¶ 32. Aizawa does not limit the increase in photodetectors to being included in only the existing single ring of detectors, i.e., the first set. Nothing in this disclosure teaches against adding a second set, as proposed by Petitioner for the well-supported reasons identified in Mendelson-2003 and further discussed by Dr. Kenny.

Patent Owner's third argument—that Mendelson-2003 is experimental and would not provide the alleged benefits—likewise fails. Patent Owner's suggestion that Mendelson-2003 teaches using a single large, wide detector ring that outputs a single signal stream is unfounded. The analysis provided in Mendelson-2003 explicitly compares a dual-ring arrangement to both a single near ring and a single far ring. *See, e.g.*, Ex. 1024, Fig. 3, Fig. 4, Table 1 (all comparing near, far, and near + far arrangements). Mendelson-2003 explains that the dual-ring arrangement "simulate[s] a single large PD area" and realizes benefits in LED power requirements. *Id.* at 3019. That



Mendelson-2003 *simulates* a single ring by using two discrete rings demonstrates the fallacy of Patent Owner’s argument.

Finally, we disagree with Patent Owner’s argument that a person of ordinary skill in the art would not have made the proposed combination because it “introduces signal processing problems requiring a *further* redesign for Aizawa’s sensor” to include a second amplifier to account for signals of different strengths between the near and far rings. PO Resp. 65–66. A person of ordinary skill in the art must be presumed to understand something about the art beyond what is disclosed in the references. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962). After all, “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007). Neither Patent Owner nor Dr. Madisetti asserts that adding a second amplifier would be beyond the level of skill in the art or would introduce any specific problems, beyond its mere addition. We credit Dr. Kenny’s testimony that a person of ordinary skill would have recognized that, in order to account for the disparate currents generated by the two rings, the rings would be separately wired with separate amplifiers (Ex. 1003 ¶ 97) and that this would have been a routine and conventional design choice, within the level of ordinary skill in the art (*id.* ¶ 94).

For the foregoing reasons, we are persuaded by Petitioner’s contentions.

- vi. “[f] each of the photodiodes of the first set of photodiodes has a corresponding window that allows light to pass through to the photodiode”  
and  
“[j] each of the photodiodes of the second set of

*photodiodes has a corresponding window that allows light to pass through to the photodiode”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa teaches windows corresponding to each detector of Aizawa, i.e., “tapered cavities that provide an opening for each of the detectors (e.g., each of the photodiodes of the first set of photodiodes) and that serve to increase, for instance, the concentration of light collected by the detectors, thereby increasing the signal to noise ratio,” and that a person of ordinary skill in the art also would have provided such windows for the second set of photodiodes, suggested by the combination with Mendelson-2003. Pet. 38–40, 42; *see, e.g.*, Ex. 1006 ¶¶ 23 (“four phototransistors 22”), 24 (“stored in cavities” and “set back from . . . detection face 23a”), Figs. 1(a)–1(b) (depicting cavities 23c housing detectors 22); Ex. 1003 ¶¶ 98–99, 103.

vii. *“[k] a wall that surrounds at least the first and second sets of photodiodes”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses holder 23, which includes a wall that surrounds the photodetectors, as well as other elements. Pet. 42–44; *see, e.g.*, Ex. 1006 ¶ 23 (“holder 23 for storing . . . light emitting diode 21 and the photodetectors 22”), Fig. 1(b) (depicting holder 23 surrounding the detector).

viii. *“[l] a cover comprising a protruding convex surface, wherein the protruding convex surface is above all of the photodiodes of the first and second sets of photodiodes, wherein at least a portion of the*

*protruding convex surface is rigid, and wherein the cover is above the wall”*

Petitioner’s Undisputed Contentions

Petitioner contends that Aizawa “teaches a light permeable cover in the form of an acrylic transparent plate 6 . . . that is mounted at the detection face 23a” of the sensor, i.e., above Aizawa’s photodetectors, to provide “improved adhesion between the detector and the wrist to ‘further improv[e] the detection efficiency of a pulse wave.’” Pet. 9–10 (citing Ex. 1006 ¶ 30, Fig. 1(b); Ex. 1003 ¶¶ 53–54). Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that “acrylic transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to the wrist 10.” Ex. 1014 ¶ 34, Fig. 1(b) (depicting transparent plate 6 between sensor 2 and wrist 10).

Petitioner also contends that Ohsaki teaches a wrist-worn sensor that includes a “translucent board” having a convex surface that contacts the user’s skin. Pet. 12–13, 22–23. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 includes detecting element 2 and sensor body 3, and is “worn on the back side of the user’s wrist.” Ex. 1014 ¶ 16. Ohsaki discloses that detecting element 2 includes package 5 and “translucent board 8[,which] is a glass board which is transparent to light, [and is] attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. As seen in Ohsaki’s Figure 2, translucent board 8 has a protruding convex surface, and is located above all of the detectors. *Id.* ¶ 17 (“The translucent board 8 is . . . attached to the opening of the package 5.”), Fig. 2.

Petitioner also contends that Ohsaki's Figure 2 depicts the user's tissue conforming to the shape of the convex surface of the cover, such that the convex surface would have been "rigid." Pet. 45–46. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki's Figure 2 depicts the user's tissue 4 conforming to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1014 ¶ 17 ("The translucent board 8 is a glass board."), Fig. 2; *see, e.g.*, Ex. 1003 ¶¶ 107–108.

#### Petitioner's Disputed Contentions

Petitioner further contends that a person of ordinary skill in the art would have found it obvious "to modify the sensor's flat cover [in Aizawa] . . . to include a lens/protrusion . . . similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, and [3] protect the elements within sensor housing." Pet. 24–25 (citing, *e.g.*, Ex. 1003 ¶ 78; Ex. 1014 ¶ 25), 44 (citing, *e.g.*, Ex. 1003 ¶ 105). Petitioner contends that Ohsaki's convex surface is in "intimate contact" with the user's tissue, which prevents slippage of the sensor and increases signal strength because "variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed" and because "disturbance light from the outside" is prevented from penetrating board 8, as compared to a sensor with a flat surface. *Id.* at 22–24 (citing, *e.g.*, Ex. 1003 ¶¶ 76–77; quoting Ex. 1014 ¶¶ 15, 17, 25).

Petitioner contends this modification would have been "nothing more than the use of a known technique to improve similar devices in the same way," *i.e.*, "simply improving Aizawa-Mendelson-2003's transparent plate 6

that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor.” Pet. 25 (citing Ex. 1003 ¶ 79). Further according to Petitioner, “the elements of the combined system would each perform functions they had been known to perform prior to the combination—Aizawa-Mendelson-2003’s transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki.” *Id.* at 26.

To illustrate its proposed modification, Petitioner includes two annotated versions of Aizawa’s Figure 1(b), both of which are reproduced below. Pet. 25.

FIG. 1 (b)

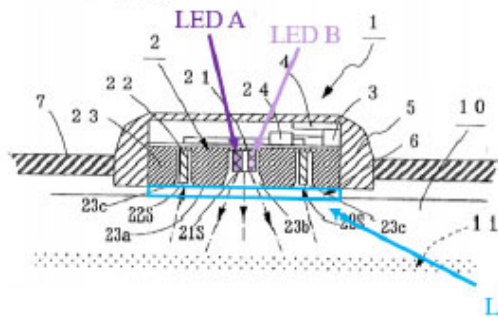
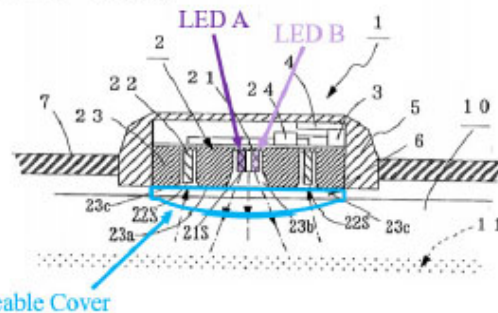


FIG. 1 (b)



Petitioner’s annotated figure on the left depicts Aizawa’s sensor, modified to include LED B (*see supra* Section II.D.5.iii) and with a flat “light permeable cover” (illustrated with blue outline); Petitioner’s annotated figure on the right depicts Aizawa’s sensor, again modified to include LED B (*see supra* Section II.D.5.iii) and with a convex “light permeable cover” (also illustrated with blue outline). Petitioner contends that, in the combination, the convex surface is above the wall provided by the holder. Pet. 45 (citing, e.g., Ex. 1003 ¶ 106).

Petitioner also identifies Japanese Patent Application 2006-296564 to Inokawa (Ex. 1007 (Japanese language); Ex. 1008 (English language

translation))), which Petitioner contends “provides an additional motivation and rationale . . . to modify Aizawa to include a cover comprising a protruding convex surface.” Pet. 26. According to Petitioner, Inokawa teaches a convex lens that “increase[s] the light-gathering ability of the LED.” *Id.* (citing Ex. 1008 ¶ 15, Fig. 2). Petitioner contends that, in view of Inokawa, a person of ordinary skill in the art would have understood how to implement Ohsaki’s convex surface in Aizawa. *Id.* at 27–28 (citing Ex. 1003 ¶¶ 82–83).

#### Patent Owner’s Arguments

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Aizawa’s sensor to include Ohsaki’s convex cover. PO Resp. 24–55;<sup>5</sup> PO Sur-reply 3–23.

First, Patent Owner argues that the proposed modification “fundamentally changes Ohsaki’s structure and eliminates the longitudinal shape that gives Ohsaki’s translucent board the ability to prevent slipping.” PO Resp. 25. This argument is premised on Patent Owner’s contention that Ohsaki’s convex cover must be rectangular, with the cover’s long direction

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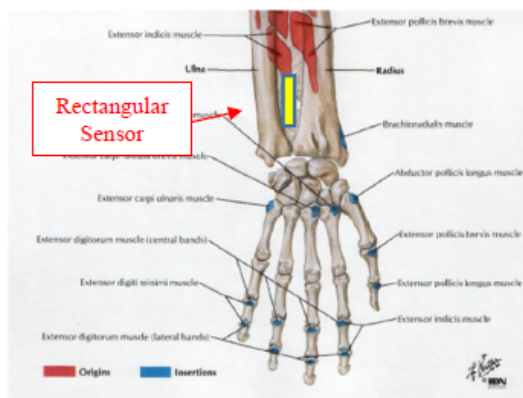
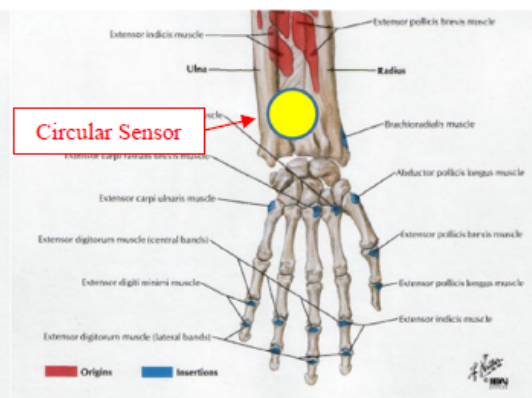
<sup>5</sup> As an initial matter, Patent Owner observes that Petitioner “[r]eli[es] on a non-ground reference, Inokawa,” as providing the rationale for the proposed modification of Aizawa in view of Ohsaki, and as providing implementation details of the combination. PO Resp. 24 (citing Pet. 26–27); *id.* at 46–47, 52–55. We discern no error in Petitioner’s identification of Inokawa. The nature of Petitioner’s reliance on Inokawa in support of this ground is explained clearly in the Petition, even if Inokawa is not listed as an additional reference in the identification of the ground. Thus, the Petition complies with 35 U.S.C. § 312(a)(3) (stating an IPR petition must “identif[y], in writing and with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge”).

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aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 26–28 (citing, e.g., Ex. 2004 ¶¶ 53–57; Ex. 1014 ¶¶ 6, 19, 23, 24). According to Patent Owner, Ohsaki teaches that “aligning the sensor's longitudinal direction with the *circumferential* direction of the user's arm undesirably results in ‘a tendency [for Ohsaki's sensor] to slip off.’” *Id.* at 28 (citing Ex. 1014 ¶ 19).

Thus, Patent Owner contends that Petitioner's proposed modification would “chang[e] Ohsaki's longitudinal detecting element and rectangular board into a circular shape[, which] would eliminate the advantages discussed above” because a circular shape “cannot be placed in *any longitudinal* direction and thus cannot coincide with the longitudinal direction of the user's wrist.” *Id.* at 28 (citing Ex. 2004 ¶¶ 57–58). Patent Owner presents annotated Figures depicting what it contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below. *Id.* at 29.

Ohsaki's Longitudinal TeachingsPetitioner's Proposed Combination

Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated Figure on the right depicts a circular sensor placed across a user's radius and

ulna. Based on these annotations, Patent Owner argues that the proposed “circular shape would press on the user’s arm in all directions and thus cannot avoid the undesirable interaction with the user’s bone structure,” such that a skilled artisan “would have understood such a change would eliminate Ohsaki’s benefit of preventing slipping.” *Id.* at 31 (citing, e.g., Ex. 2004 ¶¶ 57–58), 31 (citing Ex. 2004 ¶¶ 55–62).<sup>6</sup>

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user’s wrist to achieve any benefits, but that such a location would have been unsuitable for Aizawa’s sensor. PO Resp. 34. Specifically, Patent Owner argues that Aizawa’s sensor must be worn on the palm side of the wrist, close to radial and ulnar arteries, which is the side opposite from where Ohsaki’s sensor is worn. *Id.* at 35–40 (citing, e.g., Ex. 2004 ¶¶ 67–74). According to Patent Owner, Ohsaki teaches that the sensor’s convex surface has a tendency to slip when placed on the palm side of the wrist, i.e., in the location taught by Aizawa. *Id.* at 40–43 (citing, e.g., Ex. 1014 ¶¶ 19, 23, 24; Ex. 2004 ¶¶ 75–81). Thus, Patent Owner argues that a person of ordinary skill in the art “would not have been motivated to use Ohsaki’s longitudinal board—designed to be worn on the **back side** of a user’s wrist—with Aizawa’s **palm-side** sensor.” *Id.* at 43. Similarly, Patent Owner argues that Aizawa teaches away from the proposed modification because Aizawa teaches that its flat acrylic plate improves adhesion on the

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<sup>6</sup> Patent Owner further argues, “[t]o the extent Petitioner contends a [person of ordinary skill in the art] would use Ohsaki’s **rectangular** board on Aizawa’s circular sensor . . . this argument is unsupported and incorrect.” PO Resp. 31. We do not read the Petition as making such a contention. We understand Petitioner to propose, in essence, changing Aizawa’s circular *flat* cover into a circular *convex* cover. *See, e.g.,* Pet. 25.



palm side of the wrist, while Ohsaki teaches that its convex board “has a tendency to slip” on the palm side of the wrist. *Id.* at 43–46 (citing, e.g., Ex. 2004 ¶¶ 82–85).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki’s convex cover over Aizawa’s peripheral detectors because the convex cover would condense light toward the center and away from Aizawa’s detectors, which would decrease signal strength. PO Resp. 46–54 (citing, e.g., Ex. 2004 ¶¶ 86–97). Patent Owner also contends that Petitioner and Dr. Kenny admitted as much in a related proceeding. *Id.* at 47–48 (citing, e.g., Ex. 2019, 45; Ex. 2020, 69–70). Patent Owner also relies on Figure 14B of the ’194 patent to support its position. *Id.* at 48–49 (citing Ex. 1001, 36:3–6, 36:13–15). Additionally, Patent Owner argues that its position is also supported by Inokawa, which also uses a convex lens to direct light toward the center but, in Inokawa’s structure, the light is directed from peripheral emitters toward a central detector. *Id.* at 52–54 (citing, e.g., Ex. 1008 ¶¶ 15, 58). In light of the foregoing, Patent Owner argues that a person of ordinary skill in the art would have understood that the proposed modification would have decreased signal strength by directing light away from Aizawa’s peripheral detectors. *Id.* at 49–51.

Fourth and finally, Patent Owner argues that a person of ordinary skill in the art “would have understood that Aizawa’s *flat* plate would provide better protection than a convex surface” because it “would be less prone to scratches.” *Id.* at 54–55 (citing Ex. 1008 ¶ 106; Ex. 2004 ¶¶ 98–99).

Petitioner's Reply

Concerning Patent Owner's first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve the disclosed benefits. Pet. Reply 13–20 (citing, e.g., Ex. 1060 ¶¶ 18–30). Moreover, Petitioner asserts that “even if Ohsaki's translucent board 8 were understood to be rectangular, obviousness does not require ‘bodily incorporation’ of features from one reference into another”; rather, a person of ordinary skill in the art “would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the benefits” taught by Ohsaki. *Id.* at 16 (citing, e.g., Ex. 1060 ¶ 23). Similarly, regarding the location of the sensor, Petitioner asserts,

[E]ven assuming for the sake of argument that a [person of ordinary skill in the art] would have understood Aizawa's sensor as being limited to placement on the backside of the wrist, and would have understood Ohsaki's sensor's “tendency to slip” when arranged on the front side as informing consideration of Ohsaki's teachings with respect to Aizawa, that **would have further motivated** the [person of ordinary skill in the art] to implement a light permeable convex cover in Aizawa's sensor, to improve detection efficiency of that sensor when placed on the palm side.

*Id.* at 18 (citing, e.g., Ex. 1060 ¶ 27). In other words, Ohsaki's disclosure that a convex surface suppresses variation in reflected light would have motivated an artisan to add such a surface to Aizawa to improve detection efficiency of that sensor when placed on the palm side. *Id.* at 18–20. Moreover, Petitioner replies that the proposed convex surface “would provide an additional adhesive effect that would reduce the tendency of that

plate to slip, among other things since it is well-understood that physically digging into the skin with a protrusion provides an additional adhesive effect.” *Id.* at 20 (citing Ex. 1060 ¶ 30).

Concerning Patent Owner’s third argument, Petitioner responds that Patent Owner’s argument about a convex cover directing light to the center is belied by Ohsaki itself, which uses a convex cover over a non-centrally located detector. *Id.* (citing Ex. 1060 ¶ 31); *id.* at 30–31. According to Petitioner, Ohsaki demonstrates that even if a convex cover decreased signal strength (which it disputes), the additional benefit of reduced slippage would have been recognized by a skilled artisan. *Id.*

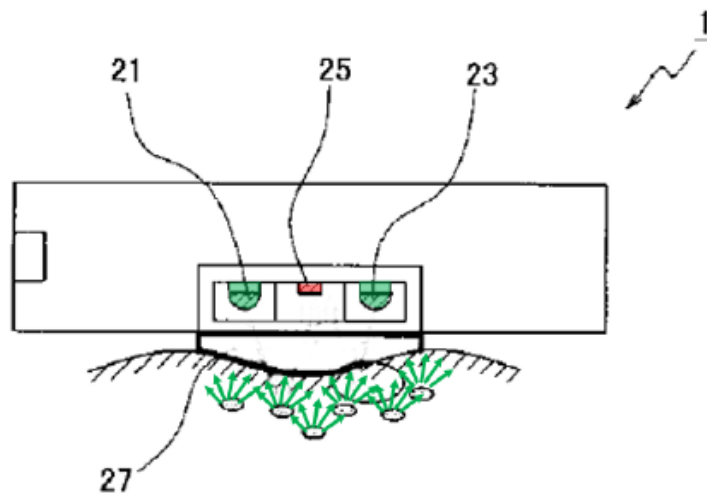
Further, Petitioner responds that adding a convex cover to Aizawa’s sensor would not decrease signal strength but, instead, “would improve Aizawa’s signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa’s photodetectors than would have with a flat cover” because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 21–22 (citing, e.g., Ex. 1060 ¶¶ 31–34).

Petitioner asserts that Patent Owner and Dr. Madisetti “ignore[] the well-known optical *principle of reversibility*,” by which “a ray going from P to S will trace the same route as one from S to P” such that “rays that are not completely absorbed by user tissue will propagate in a reversible manner.” Pet. Reply 22 (quoting Ex. 1061, 92; citing, e.g., Ex. 1061, 87–92; Ex. 1062, 106–111; Ex. 1060 ¶ 35). When applied to Aizawa’s sensor, Petitioner contends that any condensing benefit achieved by a convex cover would thus direct emitted light toward Aizawa’s peripheral detectors. *Id.* at 23–25 (citing, e.g., Ex. 1060 ¶¶ 35–44). Petitioner explains that this principle of

reversibility is recognized in Aizawa. *Id.* at 25 (citing, e.g., Ex. 1060 ¶¶ 41–44; citing Ex. 1006 ¶ 33).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue will be scattered and diffuse and will approach the detectors “from various random directions and angles.” Pet. Reply 29 (citing, e.g., Ex. 1023, 52, 86, 90; Ex. 1056, 803; Ex. 1060 ¶¶ 46–49; Ex. 2006, 163:12–164:2). This scattered and diffuse light, according to Petitioner, means that Ohsaki’s convex cover cannot focus light to the center of the sensor device, as Patent Owner argues. *Id.* at 26. Instead, due to the random nature of this scattered light, Petitioner asserts that a person of ordinary skill in the art would have understood that “Ohsaki’s convex cover provides a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.” *Id.* (citing, e.g., Ex. 1060 ¶¶ 48–49). Petitioner applies this understanding to Aizawa, and asserts that using a cover with a convex protrusion in Aizawa would “enable backscattered light to be detected within a circular active detection area surrounding” a central light source. *Id.*

Petitioner relies upon the following illustration of this alleged effect. Pet. Reply 29–30 (citing Ex. 1060 ¶¶ 54–55).



APPLE-1061, 141 (annotated)

The above illustration depicts backscattered light reflecting off user tissue and toward a convex board from various angles. *Id.* at 29. According to Petitioner, “[t]his pattern of incoming light cannot be focused by a convex lens towards any single location,” and, instead, “light rays that otherwise would have missed the active detection area are instead directed toward that area as they pass through the interface provided by the convex cover.” *Id.* at 29–30.

Finally, Petitioner dismisses Patent Owner’s reliance on Figure 14B of the ’194 patent because it “is not an accurate representation of light that has been reflected from a tissue measurement site. The light rays (1420) shown in FIG. 14B are collimated (i.e., parallel to one another), and each light ray’s path is perpendicular to the detecting surface.” Pet. Reply 28–29 (citing, e.g., Ex. 1060 ¶¶ 51–53).

Concerning Patent Owner’s fourth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the “known advantages of applying Ohsaki’s teachings,” and would not negate a motivation to

combine. *Id.* at 32 (citing, e.g., Ex. 1060 ¶ 60). Moreover, Petitioner argues that “by choosing a suitable material of the protrusion to be scratch-resistant, it would have been obvious for a [person of ordinary skill in the art] to achieve both benefits (light gathering and scratch-resistance) at once.” *Id.*

Patent Owner’s Sur-reply

Concerning Patent Owner’s first and second arguments, Patent Owner reiterates its position that Ohsaki’s purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that “even small changes in its sensor’s orientation or body location result in ‘a tendency to slip.’” PO Sur-reply 3–14, 6.

Concerning Patent Owner’s third argument, Patent Owner asserts that Petitioner’s Reply improperly presents several new theories as compared with the Petition. *Id.* at 16 (regarding reversibility), 19 (regarding refraction).

Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 15. Moreover, Patent Owner argues that Petitioner’s discussion of the principle of reversibility is “irrelevant” because “Petitioner never explains how the principle of reversibility could apply to such ‘random’ scattered and absorbed light” as is present when light interacts with user tissue. *Id.* at 16–17. The random nature of backscattered light, in Patent Owner’s view, “hardly supports Petitioner’s argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed,” and is irrelevant to the central issue presented here of “whether changing Aizawa’s flat surface to a convex surface results in more light on Aizawa’s peripherally located detectors.” *Id.* at 17–18.

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that a cover with a convex protrusion "focuses *all* light to a single point" at the center of the sensor as Petitioner characterizes it. PO Sur-reply 19. Patent Owner's position, rather, is that Petitioner has not shown that a person of ordinary skill in the art "would have been motivated to change Aizawa's flat surface to a convex surface to improve signal strength." *Id.* In Patent Owner's view, by arguing that the convex cover provides only a "*slight* refracting effect," Petitioner undermines its contention that providing such a cover would have improved detection efficiency. *Id.* at 20.

Moreover, Patent Owner argues that Petitioner's theory regarding the "slight refracting effect" of a convex protrusion is "unavailing because it fails to consider the greater *decrease* in light at the detectors due to light redirection to a *more* central location." *Id.* at 20. According to Patent Owner, any light redirected from the sensor's edge could not make up for the loss of signal strength from light redirected away from the detectors and toward the center. *Id.*

Concerning Patent Owner's fourth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover would be less prone to scratches and offers "*no* plausible advantages for its asserted combination." *Id.* at 23. Moreover, Patent Owner argues that "[t]he risk of scratches undermines Petitioner's argument that a [person of ordinary skill in the art] would have been motivated to add a convex cover to 'protect the elements within the sensor housing.'" *Id.*

### Analysis

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have modified Aizawa's flat cover to include a protruding convex surface, such as that taught by Ohsaki, to (1) improve adhesion between the sensor and the user's tissue, (2) improve detection efficiency, and (3) protect the elements within the sensor housing. Pet. 24–25. We conclude all three rationales are supported by the evidence, as follows.

### Rationales 1 and 2

The evidence of record persuades us that adding a convex protruding surface, such as that taught by Ohsaki, to Aizawa's cover would have improved adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.* Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1014 ¶ 25 (emphases added); *see also id.* ¶ 27 (“stably fixed”).

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a



convex surface to Aizawa to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist. *See, e.g.*, Ex. 1003 ¶¶ 76 (“[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor.”), 78–79. We also credit Dr. Kenny's testimony that, in light of these teachings, a person of ordinary skill in the art would have made such a modification to improve the pulse sensor's ability to emit light into, and detect light reflected from, the user's wrist, to generate an improved pulse signal. Ex. 1003 ¶¶ 76–78; Ex. 1060 ¶¶ 13, 29.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1014, Figs. 4A–4B, ¶¶ 15, 25 (stating that with “a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4,” and with “a convex surface like the present embodiment, the variation of the amount of the reflected light” collected by the sensor “is suppressed”). Ohsaki also states that, with a convex surface, “[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.” *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the skill level of an ordinary artisan. For example, Dr. Kenny testifies:

[A person of ordinary skill in the art] would have combined the teachings of Aizawa-Mendelson-2003 and Ohsaki as doing so would have amounted to nothing more than the use

of a known technique to improve similar devices in the same way. For instance, [a person of ordinary skill in the art] would have recognized that incorporating Ohsaki's convex surface is simply improving Aizawa-Mendelson-2003's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor. Furthermore, the elements of the combined system would each perform similar functions they had been known to perform prior to the combination. That is, Aizawa-Mendelson-2003's transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki.

Ex. 1003 ¶ 79. In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through third arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user's forearm. PO Resp. 25–34. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1014 ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex protrusion.

We disagree with Patent Owner’s suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki’s Figures 1 and 2. PO Resp. 18–20. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.,* Ex. 1014 ¶ 13 (“schematic diagram”); Pet. Reply 14–15; *Hockerson-Halberstadt, Inc. v. Avia Group Int’l*, 222 F.3d 951, 956 (Fed. Cir. 2000) (“[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.”).

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: “[T]he length of the detecting element from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side.” Ex. 1014 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user’s forearm: “[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user’s arm,” to avoid slipping off. *Id.*; *see also id.* ¶ 9 (“The light emitting element and the light receiving element are arranged in the longitudinal direction of the user’s arm.”).

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki’s convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner’s argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 13–14. We have considered the testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1060 ¶¶ 10, 12, 18–23; Ex. 2004 ¶¶ 36–39 (relying on Ohsaki’s Figures 1–2 to support the opinion that the convex surface is rectangular). Dr. Madisetti’s

reliance on the dimensions of Ohsaki's figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny's testimony that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. PO Resp. 26–28; PO Sur-reply 10 (“[A] POSITA would have understood Ohsaki's convex board must *also* have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm.”). Although Ohsaki recognizes that interaction with these bones can cause problems, (*see* Ex. 1014 ¶¶ 6, 19), we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 29, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. *See, e.g.*, Ex. 1060 ¶ 25 (“The gap between the ulna and radius bones at the forearm is even greater than the gap between bones at the wrist, which is already wide enough to easily accommodate a range of sensor sizes and shapes, including circular shapes.”). “A person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR*, 550 U.S. at 421.

After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d at 516.

Finally, we do not agree with Patent Owner’s position that Ohsaki’s advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki’s convex surface is rectangular at all. Moreover, even if Ohsaki’s convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that “detecting element 2 is arranged on the user’s wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user’s skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user’s wrist 4.” Ex. 1014 ¶ 25; Ex. 1060 ¶¶ 10 (“Ohsaki does not limit its benefits to a rectangular sensor applied to a particular body location, and a [person of ordinary skill in the art] would not have understood those benefits as being so limited.”), 12. Thus, we agree with Petitioner that Ohsaki’s teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa’s circular-shaped sensor, to improve adhesion as taught by Ohsaki. Nothing in Ohsaki’s disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1060 ¶¶ 10–23.

Moreover, Ohsaki contrasts the ability to properly receive reflected light with a convex surface as compared to a flat surface and notes that,

in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user’s skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.

Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1014 ¶ 25; Ex. 1060 ¶¶ 12–13. Again, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's sensor, to improve signal strength, as taught by Ohsaki. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Aizawa and Ohsaki.

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is the opposite side of the wrist taught by Aizawa. PO Resp. 34–46. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. *See, e.g.*, Pet. 24–25. In other words, Petitioner's proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki's Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when the element is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1014 ¶¶ 23–24, Figs. 3A–3B. However, we do not agree that these figures support Dr. Madisetti's conclusion that “Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different

locations or orientations” such as the palm side of the wrist—particularly in comparison to a flat surface such as Aizawa’s. Ex. 2004 ¶¶ 67–81. Instead, Ohsaki acknowledges that, even when the detecting element is located “on the front [palm] side of the user’s wrist 4, *the pulse wave can be detected well* if the user is at rest.” Ex. 1014 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user’s wrist achieves benefits. *Id.* Notably, the claims are not limited to detection during movement or exercise.

We credit, instead, Dr. Kenny’s testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa’s sensor. *See* Ex. 1060 ¶¶ 10–11, 15–16, 24–30. Dr. Kenny acknowledges that

certain locations present anatomical features that provide for easy measurement of large reflected light signals and other locations present anatomical features that reduce the amplitude of the reflected light signals. Because of this, a [person of ordinary skill in the art] would be motivated to search for features from other references that can provide improved adhesion, improved light gathering, reduced leakage of light from external sources, and protection of the elements within the system in order to successfully detect a pulse wave signal from many locations.

*Id.* ¶ 16. We credit Dr. Kenny’s testimony that, in light of Ohsaki’s teaching of a convex protrusion in “intimate contact with the surface of the user’s skin,” a skilled artisan would have understood that such a surface “would have increased adhesion and reduced slippage of Aizawa’s sensor when placed on either side of a user’s wrist or forearm, and additionally would have provided associated improvements in signal quality.” *Id.* ¶ 29.

Dr. Madisetti testifies that “[b]ased on Aizawa’s teaching that a flat acrylic plate improves adhesion on the palm side of the wrist, and Ohsaki’s

teaching that a convex surface tends to slip on the palm side of the wrist, a [person of ordinary skill in the art] would have come to the opposite conclusion from Dr. Kenny: that modifying Aizawa's flat adhesive plate 'to include a lens/protrusion . . . similar to Ohsaki's translucent board' would not 'improve adhesion.'" Ex. 2004 ¶ 85. We disagree with this reading of Aizawa. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate "improve[s] adhesion" (*id.* ¶ 13). Aizawa further states: "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *Id.* ¶¶ 30, 34 ("Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved . . ."). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with. Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa's detector to the user's wrist.

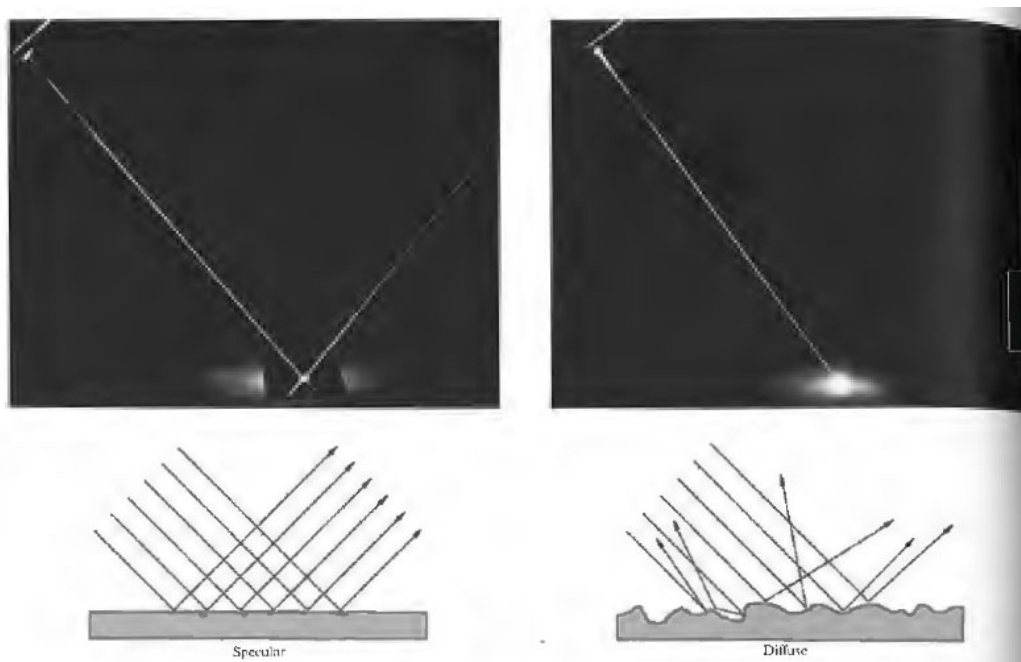
We have considered Patent Owner's third argument that a convex cover would condense light away from Aizawa's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 46–54. We disagree.

There appears to be no dispute that when emitted light passes through user tissue, the light diffuses and scatters as it travels. *See, e.g.,* Pet. Reply 25 ("[R]eflectance-type sensors work by detecting light that has been



‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.’ A [person of ordinary skill in the art] would have understood that light that backscatters from the measurement site after diffusing through tissue reaches the active detection area from various random directions and angles.”) (quoting Ex. 1023, 86); PO Sur-reply 16–17 (“Even Petitioner admits, however, that tissue randomly scatters and absorbs light rays, which would cause forward and reverse light paths to be unpredictable and very likely different.”).

The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner. Exhibit 1061,<sup>7</sup> Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:



This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a

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<sup>7</sup> Eugene Hecht, *Optics* (2nd ed. 1990).

rough surface. *See* Ex. 1061, 87–88 (original page numbers). The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*; *see also* Ex. 1060 ¶¶ 38–39 (discussing Ex. 1061, Figure 4.12), 46 (“A [person of ordinary skill in the art] would have understood that light that backscatters from the measurement site (after diffusing through tissue) reaches the active detection area from many random directions and angles.”).

Dr. Kenny testifies that Aizawa’s sensor “detect[s] light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.’” Ex. 1060 ¶ 53 (quoting Ex. 1023, 86). Dr. Kenny further opines that a convex cover, when added to Aizawa’s sensor with multiple detectors symmetrically arranged about a central light source, “allows light rays that otherwise would have missed the detection area to instead be directed toward that area as they pass through the interface provided by the cover,” thus increasing the light-gathering ability of Aizawa’s sensor. *Id.* ¶ 49.

By contrast Dr. Madisetti testifies that “a convex ‘lens/protrusion’ would direct light away from the detectors and thus result in decreased light collection and optical signal strength at the peripheral detectors” because it condenses light towards the center of the sensor and away from the peripheral detectors. Ex. 2004 ¶¶ 86–87, 90. We have considered this testimony, however, Dr. Madisetti’s opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* ¶ 89. Dr. Madisetti does not explain how light

would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 87–90; *see also id.* ¶¶ 91–97 (addressing motivation and also failing to discuss diffuse, scattered light). In other words, even if Patent Owner is correct that the '194 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light reflected by a user's tissue is scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that “Petitioner and Dr. Kenny both [previously admitted] that a convex cover condenses light towards the center of the sensor and away from the periphery,” in a different petition filed against a related patent, i.e., in IPR2020-01520. PO Resp. 47–48; Ex. 2004 ¶ 87. The cited portions of the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the “mean path length” of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny's testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Aizawa's symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. *See, e.g.*, Ex. 1060 ¶¶ 31 (“[A] cover featuring a convex protrusion would improve Aizawa's signal-to- noise ratio by causing more light backscattered from tissue to strike Aizawa's photodetectors than would have with a flat cover.”), 34 (“improves ‘light concentration at pretty much *all of the locations under the curvature of the lens*’”), 46 (“A [person of

ordinary skill in the art] would have understood that light which backscatters from the measurement site after diffusing through tissue reaches the active detection area from various random directions and angles.”), 49 (“[L]ight rays that may have otherwise missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.”); *see generally id.* ¶¶ 31–59. We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface.

We additionally do not agree with Patent Owner’s argument that Petitioner’s Reply presents new theories that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of, *inter alia*, increasing the light gathering ability of Aizawa’s device. *See* Pet. 24–25. Patent Owner’s Response then challenged that contention, with several arguments that Petitioner’s proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See* PO Resp. 46–54. This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019) (“Consolidated Guide”),<sup>8</sup> 73 (“A party also may submit rebuttal evidence in support of its reply.”). This is what Petitioner did here. The Reply does not change Petitioner’s theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 22–28, *with* Reply 20–31.

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<sup>8</sup> Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

Rationale 3

Petitioner further contends that a person of ordinary skill in the art would have recognized that a cover with a protruding convex surface, such as that taught by Ohsaki, would “protect the elements within the sensor housing” of Aizawa. Pet. 24–25. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would also protect the sensor’s internal components in a manner similar to Aizawa’s flat acrylic plate. Ex. 1003 ¶ 105; Ex. 1060 ¶ 60; *see also* Ex. 1008 ¶ 15 (noting that a cover “protect[s] the LED or PD”).

We disagree with Patent Owner’s fourth argument that a person of ordinary skill in the art would not have modified Aizawa as proposed because a convex cover would be prone to scratches and because other alternatives existed. Patent Owner does not explain how the potential presence of scratches on a convex cover would preclude that cover’s ability to, nonetheless, protect the internal sensor components in Aizawa, as Petitioner proposes. That a convex cover may be more prone to scratches than Aizawa’s flat cover is one of numerous tradeoffs that a person of ordinary skill in the art would consider in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). Moreover, as Petitioner notes, and Patent Owner does not dispute, a scratch resistant material could be employed in fabricating the cover. Pet. Reply 32; PO Sur-reply 23. The record does not support the premise that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

- ix. “[m] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises”

#### Petitioner's Contentions

Petitioner contends Aizawa teaches a sensor device that uploads data to an external display, but notes that Aizawa “is silent about how such data transmission would be implemented.” Pet. 28 (citing Ex. 1006 ¶¶ 15, 23, 35; Ex. 1003 ¶ 84). Petitioner contends that Mendelson-2006 teaches that a body-worn sensor wirelessly communicates data to a body-worn receiver module, and the receiver module then wirelessly communicates data to a handheld PDA. *Id.* at 14, 28–29, 47.<sup>9</sup> Petitioner additionally contends that a person of ordinary skill in the art would have “found it obvious and straightforward to further modify Aizawa-Mendelson-2003-Ohsaki in view of Mendelson-2006 to yield a pulse detector that can transmit data to an external device—i.e., handheld computing device—for monitoring” and “to enable a convenient and user-friendly interface with Aizawa's detector (which does not include a separate display/interface) and the ability to

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<sup>9</sup> At pages 47–48, the Petitioner refers to “Mendelson-2003” when discussing the receiver module and PDA. *See, e.g.*, Pet. 47 (contending that the modified system “includes Aizawa's wrist-worn sensor device that is in communication with Mendelson-2003's body-worn receiver module (below left) and PDA (below right)”). The cited disclosures, however, appear in Mendelson-2006, as Petitioner's citations confirm. *Id.* at 47–48 (citing Ex. 1016). Therefore, it appears these references to “Mendelson-2003” are inadvertent typographical errors, and that “Mendelson-2006” was intended. *See also id.* at 28–29 (referring to Mendelson-2006's receiver module and PDA).

remotely monitor the user's physiological parameters." Pet. 28–29; *see, e.g.*, Ex. 1003 ¶¶ 85–86.

#### Patent Owner's Arguments

Patent Owner does not dispute Petitioner's contentions regarding the proposed combination with Mendelson-2006 to address this limitation. Patent Owner does argue, however, that "Mendelson 2006 confirms that Petitioner's arguments regarding Mendelson 2003's two-ring detector arrangement are meritless." PO Resp. 67. According to Patent Owner, Mendelson-2006 confirms that a skilled artisan would have used a single annular photodetector to reduce power consumption. *Id.* (citing Ex. 1016, 1, 4, Fig. 2).

#### Analysis

We are persuaded by Petitioner's undisputed contentions regarding this limitation. We agree that Mendelson-2006 teaches wireless communication between a sensor and a handheld computing device, i.e., a PDA. *See, e.g.*, Ex. 1016, 1–2 (describing system), Fig. 1 (sensor attached to skin), Fig. 3 (PDA). We are persuaded that Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the un rebutted testimony of Dr. Kenny, who opines that such a modification would enable a convenient and user-friendly interface with Aizawa's sensor. Ex. 1003 ¶ 86; *id.* ¶¶ 84–86, 109–111.

We also have considered Patent Owner's argument as it relates to limitations [c–e] and [g–i], but we do not agree. As noted above, Petitioner provides persuasive evidence demonstrating that the proposed combination would have realized power savings. *See, e.g.*, Ex. 1024, 3019, Table 1.

- x. *“[n] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user”*

The cited evidence supports Petitioner’s undisputed contention that, in the proposed combination, Mendelson-2006’s receiver includes a microcontroller (processor) that wirelessly receives signals from Aizawa’s sensor and transmits them to the PDA. Pet. 50; *see, e.g.*, Ex. 1016, 1, 2 (“The information acquired by the Sensor Module is transmitted wirelessly via an RF link over a short range to a body-worn Receiver Module. The data processed by the Receiver Module can be transmitted wirelessly to a PDA.”), 3 (explaining that the PDA “has sufficient computational resources for the intended application” and “can also serve to temporarily store vital medical information received from the wearable unit”), Fig. 3 (displaying SpO<sub>2</sub> and HR data); Ex. 1003 ¶¶ 112–113.

- xi. *“[o] a touch-screen display configured to provide a user interface, wherein: [p] the user interface is configured to display indicia responsive to measurements of the physiological parameter, and [q] an orientation of the user interface is configurable responsive to a user input”*

The cited evidence supports Petitioner’s undisputed contention that, in the proposed combination, Mendelson-2006 describes a PDA with a touchscreen display configured to display indicia responsive to measurements of, e.g., SpO<sub>2</sub> and HR. Pet. 51–52; *see, e.g.*, Ex. 1016, 3 (“The use of a PDA . . . also provides a low-cost touch screen interface.”), Fig. 3 (displaying SpO<sub>2</sub> and HR data).



Petitioner acknowledges that “Mendelson-2006 does not explicitly state that an orientation of the GUI provided by the PDA is configurable responsive to a user input.” Pet. 52. However, Petitioner contends that a person of ordinary skill in the art would have understood that the “‘LabVIEW program’ . . . [and] the ‘Windows CE™’ operating system” would have “enabled users to dynamically switch the screen orientation between portrait and landscape modes.” *Id.* at 53; *see, e.g.*, Ex. 1003 ¶¶ 116–118.

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art “would have found it obvious to make an orientation of the PDA’s user interface configurable responsive to a user input, for the sake of user convenience.” Pet. 53; *see, e.g.*, Ex. 1003 ¶ 118. Petitioner’s stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny, who testifies as to the convenience of the combination. *See, e.g.*, Ex. 1003 ¶¶ 114–118.

*xii. “[r] a storage device configured to at least temporarily store at least the measurements of the physiological parameter.”*

The cited evidence supports Petitioner’s undisputed contention that, in the proposed combination, Mendelson-2006 teaches that the PDA is configured to store vital medical information received from the wearable pulse oximeter, and that an ordinarily skilled artisan “would have understood that the vital medical information would have included measurements of the physiological parameters obtained by the physiological sensor device (e.g., HR).” Pet. 54; Ex. 1016, 3 (“The PDA can also serve to temporarily store vital medical information received from the wearable unit.”); Ex. 1003

¶ 120. Thus, Petitioner contends that a person of ordinary skill in the art “would have configured a storage device of the PDA to at least temporarily store measurements of physiological parameters (e.g., HR).” Pet. 53; *see, e.g.*, Ex. 1003 ¶¶ 119–120.

*xiii. Summary*

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

*6. Dependent Claims 2–18*

Petitioner contends that claims 2–18 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1.

*i. Dependent Claims 2–12, 14–16, 18*

Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 54–70, 72–75. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 121–146, 150–152, 154.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 68 (“[T]he Petition fails to establish that independent claims 1, 20, and 30 are obvious in view of the cited references of Ground 1 and therefore

fails to establish obviousness of any of the challenged dependent claims.”); *see supra* § II.D.5.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–12, 14–16, 18 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

*ii. Dependent Claims 13 and 17*

Dependent claim 13 ultimately depends from independent claim 1 and further recites “the protruding convex surface protrudes a height between 1 millimeter and 3 millimeters.” Ex. 1001, 46:49–51.

Dependent claim 17 ultimately depends from independent claim 1 and further recites “the protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters.” *Id.* at 47:1–3.

Petitioner contends that the sensor rendered obvious by the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Mendelson-2006 would have included a cover with a protruding convex surface. *See supra* § II.D.5.viii. With respect to claim 13, Petitioner contends that a person of ordinary skill in the art “would have found it obvious that a device designed to fit on a user’s wrist would be on the order of millimeters,” consistent with Ohsaki’s disclosure that the device is in “intimate contact” with the user’s skin. Pet. 70–71 (citing, e.g., Ex. 1003 ¶¶ 148–149). Petitioner also contends that an ordinarily skilled artisan would have taken user comfort into account when establishing the dimensions of the device’s convex cover. *Id.* With these considerations in mind, Petitioner contends that, “in order to provide a comfortable cover that prevents slippage, the convex surface

should protrude a height between 1 millimeter and 3 millimeters,” because “there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable to the user.” *Id.* (citing, e.g., Ex. 1003 ¶ 149). With respect to claim 17, Petitioner incorporates its contentions regarding claim 13. Pet. 75; Ex. 1003 ¶ 153.

Patent Owner argues that none of the cited references discloses the claimed height range and that Petitioner relies on hindsight reconstruction. PO Resp. 59 (citing, e.g., Ex. 2004 ¶¶ 121–125). Patent Owner also characterizes Dr. Kenny’s testimony as conclusory and unsupported. *Id.* at 71–72.

Petitioner is correct that, “[w]hen there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense.” *KSR*, 550 U.S. at 398. Petitioner has shown sufficiently that only a finite number of solutions existed with respect to the height of a convex protrusion on a tissue-facing sensor, which would have met the art-recognized goals of both (1) intimate contact between the sensor’s surface and the user and (2) user comfort. *See, e.g.*, Ex. 1014 ¶¶ 6, 25. Bearing in mind these considerations, we credit Dr. Kenny’s testimony that it would have been obvious, “in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, [that] the surface should protrude a height between 1 millimeter and 3 millimeters,” as recited in claim 13, and which further includes the claimed range of 2 to 3 millimeters as recited in claim 17. Ex. 1003 ¶ 149. Further, the record does

not support that any new and unexpected results were achieved at the claimed height greater than 2 millimeters and less than 3 millimeters. *See, e.g.,* Ex. 1001, 23:43–50 (“The height 430 can be from about 0.5 millimeters to about 3 millimeters, e.g., about 2 millimeters. In an embodiment, the dimensions 400, 410, and 430 can be selected such that the measurement site contact area 470 includes an area of about 80 square millimeters, although larger and smaller areas can be used for different sized tissue for an adult, an adolescent, or infant, or for other considerations.”).

We have considered Patent Owner’s argument, and Dr. Madisetti’s cited testimony. However, it is not dispositive that none of the cited references teaches the claimed range. PO Resp. 69; Ex. 2004 ¶ 121. Petitioner relies upon the knowledge, ability, and creativity of a person of ordinary skill in the art, not the teachings of a specific reference. Notably, Dr. Madisetti does not dispute Dr. Kenny’s position that there were a finite number of options available for the height of the convex surface. Ex. 2004 ¶¶ 121–125. Therefore, we do not agree that Petitioner’s contentions are rooted in impermissible hindsight. *See, e.g., In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) (“Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.”).

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that

claims 13 and 17 would have been obvious over the cited combination of references.

*7. Claims 20 and 22–30*

Independent claim 20 consists of limitations that are substantially similar to elements [a]–[j] and [l]–[m] of claim 1. *Compare* Ex. 1001, 45:2–49, *with id.* at 47:9–36. In asserting that claim 20 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Mendelson-2006, Petitioner refers to the contentions made regarding claim 1. *See* Pet. 75–76; Ex. 1003 ¶¶ 155–161.

Dependent claims 22–29 all depend directly or indirectly from independent claim 20. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 76–79. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 162–181.

Independent claim 30 includes limitations similar to limitations [a]–[r] of claim 1, and also includes additional recitations. *Id.* at 48:38–50:21 (reciting also a “substrate” and certain “preprocessing electronics”). In asserting that claim 30 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Mendelson-2006, Petitioner refers to the contentions made regarding claim 1, as well as claims depending therefrom. *See* Pet. 79–82; Ex. 1003 ¶¶ 182–208.

Patent Owner does not present any argument for these claims other than those we have already considered with respect to independent claim 1 and dependent claims 13 and 18. PO Resp. 12–72.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 20 and 22–30 would have been obvious over the cited combination of references. *See supra* II.D.5–6; Ex. 1003 ¶¶ 155–208.

## 8. *Summary*

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–18, 20, and 22–30 would have been obvious over the cited combination of references.

### *E. Obviousness over the Combined Teachings of Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006, and Beyer*

Petitioner contends that claims 19 and 21 of the '194 patent would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006, and Beyer. Pet. 82–85.

#### *1. Overview of Beyer (Ex. 1019)*

Beyer is a U.S. patent titled “Cellular Phone/PDA Communication System,” and discloses a “cellular PDA communication system for allowing a plurality of cellular phone users to monitor each others’ location and status[ and] to initiate cellular phone calls.” Ex. 1019, code (57). Beyer’s Figure 1 is reproduced below.

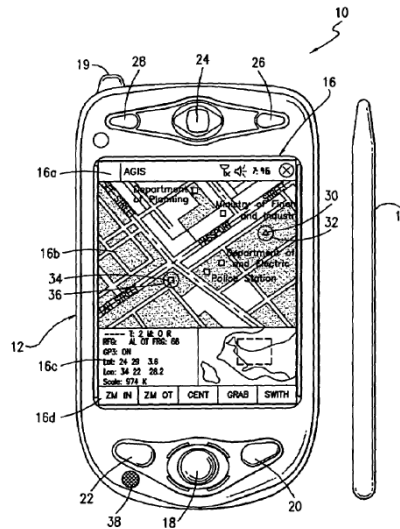


FIG. 1

Figure 1 depicts a “cellular phone/PDA and display.” *Id.* at 7:8–9.

## 2. Analysis

Claims 19 and 21 depend directly from independent claims 1 and 20, respectively, and recite that “the handheld computing device comprises a mobile phone.” Ex. 1001, 47:6–8, 47:37–39.

Petitioner contends that claims 19 and 21 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006, and Beyer. Pet. 82–85. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of this claim, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 82–85; Ex. 1019, 1:6–15, Fig. 1. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 209–212.

Patent Owner does not present any argument for these claims other than those we have already considered with respect to independent claim 1.



PO Resp. 72 (“Ground 2 does not fix the deficiencies in Ground 1.”); *see supra* § II.D.

We have considered the evidence and arguments of record, including those directed to claim 1 and addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 19 and 21 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006, and Beyer for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Pet. 82–85; Ex. 1019, 1:6–15, Fig. 1; Ex. 1003 ¶¶ 209–212.

### III. CONCLUSION

In summary:<sup>10</sup>

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–18, 20, 22–30	103	Aizawa, Mendelson- 2003, Ohsaki, Mendelson- 2006	1–18, 20, 22– 30	
19, 21	103	Aizawa, Mendelson- 2003, Ohsaki, Mendelson- 2006, Beyer	19, 21	
<b>Overall Outcome</b>			1–30	

### IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–30 of the '194 patent have been shown to be unpatentable; and

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<sup>10</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2020-01716  
Patent 10,702,194 B1

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC.,  
Petitioner,

v.

MASIMO CORPORATION,  
Patent Owner.

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IPR2020-01733  
Patent 10,702,195 B1

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Before JOSIAH C. COCKS, ROBERT L. KINDER, and  
AMANDA F. WIEKER, *Administrative Patent Judges*.

WIEKER, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

### *A. Background*

Apple Inc. (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–17 (“challenged claims”) of U.S. Patent No. 10,702,195 B1 (Ex. 1001, “the ’195 patent”). Paper 2 (“Pet.”). Masimo Corporation (“Patent Owner”) waived filing a preliminary response. Paper 6 (“PO Waiver”). We instituted an *inter partes* review of all challenged claims 1–17 on all grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 7 (“Inst. Dec.”).

After institution, Patent Owner filed a Response (Paper 15, “PO Resp.”) to the Petition, Petitioner filed a Reply (Paper 19, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 22, “PO Sur-reply”). An oral hearing was held on February 9, 2022, and a transcript of the hearing is included in the record. Paper 32 (“Tr.”).

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–17 of the ’195 patent are unpatentable.

### *B. Related Matters*

The parties identify the following matters related to the ’195 patent: *Masimo Corporation v. Apple Inc.*, Civil Action No. 8:20-cv-00048 (C.D. Cal.);

*Apple Inc. v. Masimo Corporation*, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01716 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2); and

*Apple Inc. v. Masimo Corporation*, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1).

Pet. 95–96; Paper 3, 3–4.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the '195 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 3, 1–2.

### *C. The '195 Patent*

The '195 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on July 7, 2020, from U.S. Patent Application No. 16/834,467, filed March 30, 2020. Ex. 1001, codes (21), (22), (45), (54). The '195 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The '195 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:49–51. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g.,



oxygen or glucose. *Id.* at 2:40–46, 3:8–9. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:56–59.

Figure 1 of the '195 patent is reproduced below.

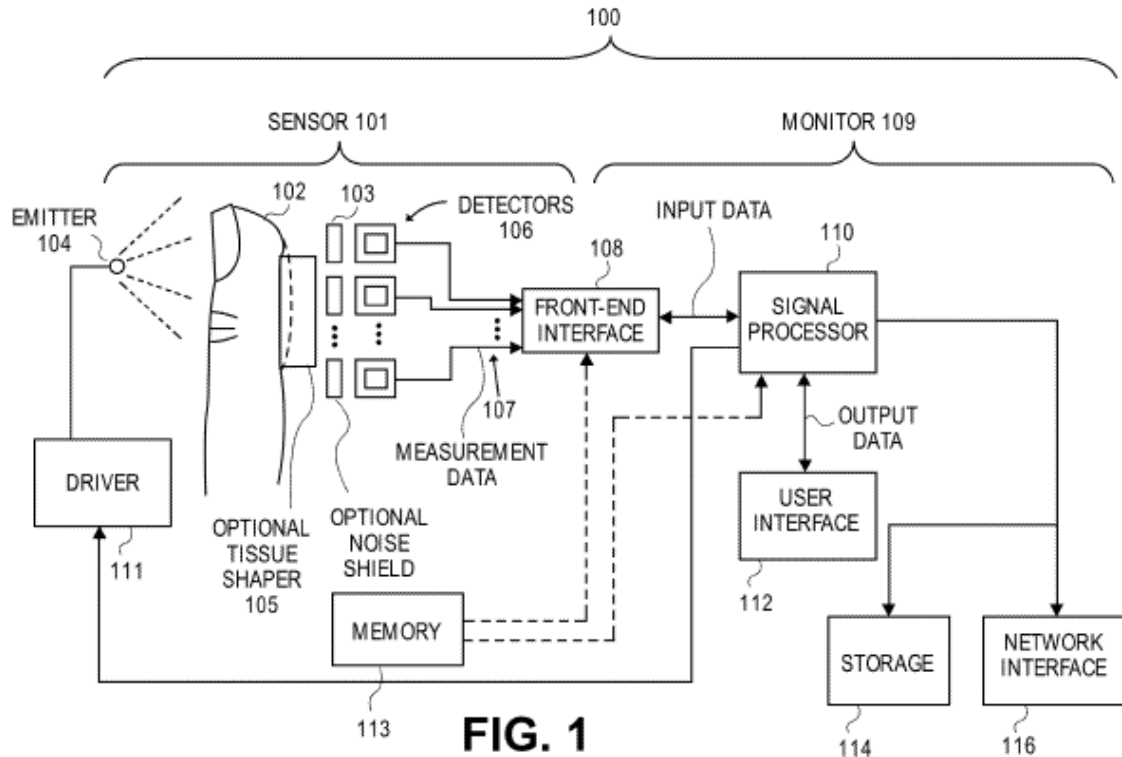


Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:56–67. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 12:1–5. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 14:11–16. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:16–19, 36–42. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces

the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:7–23.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:27–29. “[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors.” *Id.* at 15:32–35. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:57–67. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 16:4–22.

The '195 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

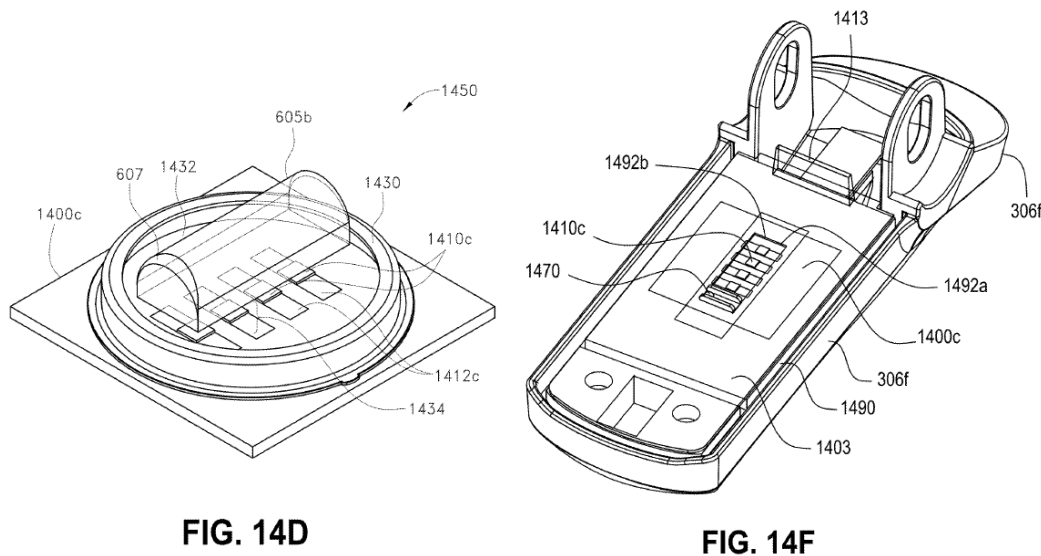
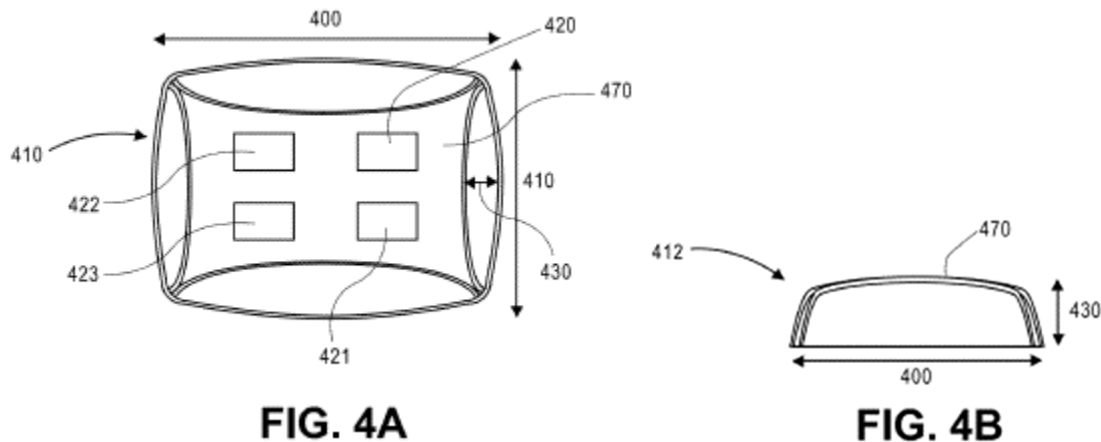


Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:54–57. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:51–54, 36:45–52.

Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:25–33. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:63–65.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.



Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:30–36. “[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site.” *Id.* “For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site.” *Id.* at 23:53–55. The measurement site contact area may include windows 420–423 that “mimic or approximately mimic a configuration of, or even house, a plurality of detectors.” *Id.* at 23:61–24:8.

#### *D. Illustrative Claim*

Of the challenged claims, claims 1 and 16 are independent. Claim 1 is illustrative and is reproduced below.

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Patent 10,702,195 B1

1. A user-worn physiological measurement device that defines a plurality of optical paths, the physiological measurement device comprising:

[a] one or more emitters configured to emit light into tissue of a user;

[b] a first set of photodiodes positioned on a first surface and surrounded by a wall that is operably connected to the first surface, wherein:

[c] the first set of photodiodes comprises at least four photodiodes, and

[d] the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream;

[e] a second set of photodiodes positioned on the first surface and surrounded by the wall, wherein:

[f] the second set of photodiodes comprises at least four photodiodes, and

[g] the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream; and

[h] a cover located above the wall and comprising a single protruding convex surface configured to be located between tissue of the user and the first and second sets of photodiodes when the physiological measurement device is worn by the user,

[i] wherein the physiological measurement device provides a plurality of optical paths, wherein each of the optical paths:

[j] exits an emitter of the one or more emitters,

[k] passes through tissue of the user,

[l] passes through the single protruding convex surface, and

[m] arrives at a corresponding photodiode of the at least one of the first or second sets of photodiodes, the

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Patent 10,702,195 B1

corresponding photodiode configured to receive light emitted by the emitter after traversal by the light of a corresponding optical path of the plurality of optical paths and after attenuation of the light by tissue of the user.

Ex. 1001, 44:63–45:34 (bracketed identifiers [a]–[m] added). Independent claim 16 includes limitations substantially similar to limitations [a]–[h] and includes additional limitations drawn to “a plurality of windows,” “preprocessing electronics,” “one or more processors,” a “network interface,” a “touch-screen display,” and “storage device,” a “strap,” and “a plurality of optical paths.” *Id.* at 46:63–48:39.

#### *E. Applied References*

Petitioner relies upon the following references:

Ali et al., U.S. Patent No. 6,584,336 B1, filed March 1, 2000, issued June 24, 2003 (Ex. 1046, “Ali”);

Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1014, “Ohsaki”);

Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, “Aizawa”);

Goldsmith et al., U.S. Patent Application Publication No. 2007/0093786 A1, filed July 31, 2006, published April 26, 2007 (Ex. 1027, “Goldsmith”); and

Y. Mendelson, et al., “Measurement Site and Photodetector Size Considerations in Optimizing Power Consumption of a Wearable Reflectance Pulse Oximeter,” Proceedings of the 25th IEEE EMBS Annual International Conference, 3016–3019 (2003) (Ex. 1024, “Mendelson-2003”).

Pet. 1–2. Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003) and the Second Declaration of Thomas W. Kenny (Ex. 1060). Patent Owner submits, *inter alia*, the Declaration of Vijay K.

Madisetti, Ph.D. (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this and other proceedings. *See* Exs. 1053–1054, 1056, 1059, 2006–2009, 2026–2027.

*F. Asserted Grounds*

Petitioner asserts that claims 1–17 are unpatentable based upon the following grounds (Pet. 1–2):

Claims Challenged	35 U.S.C. §	References/Basis
1–17	103	Aizawa, Mendelson-2003, Ohsaki, Goldsmith
1–17	103	Aizawa, Mendelson-2003, Ohsaki, Goldsmith, Ali

II. DISCUSSION

*A. Claim Construction*

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 3. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 9.

We agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

*B. Principles of Law*

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such

that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.<sup>1</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

### *C. Level of Ordinary Skill in the Art*

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having “a Bachelor of Science degree in an academic

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<sup>1</sup> Patent Owner does not present objective evidence of non-obviousness.

discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information.” Pet. 3 (citing Ex. 1003 ¶¶ 21–22). “Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline.” *Id.*

Patent Owner makes several observations regarding Petitioner’s identified level of skill in the art but, “[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner’s asserted level of skill.” PO Resp. 9 (citing Ex. 2004 ¶¶ 30–32).

We adopt Petitioner’s assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

*D. Obviousness over the Combined Teachings of  
Aizawa, Mendelson-2003, Ohsaki, and Goldsmith*

Petitioner contends that claims 1–17 of the ’195 patent would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith. Pet. 6–85.

*1. Overview of Aizawa (Ex. 1006)*

Aizawa is a U.S. patent application publication titled “Pulse Wave Sensor and Pulse Rate Detector,” and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient’s artery. Ex. 1006, codes (54), (57).



Figure 1(a) of Aizawa is reproduced below.

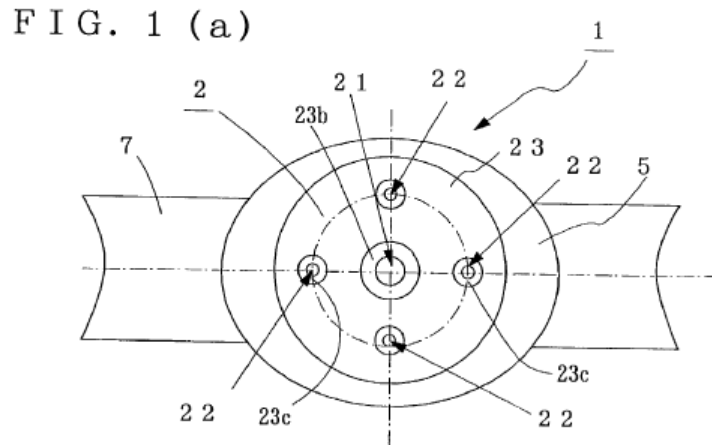


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode (“LED”) 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, “to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased.” *Id.* ¶ 32, Fig. 4(a). “The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22.” *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

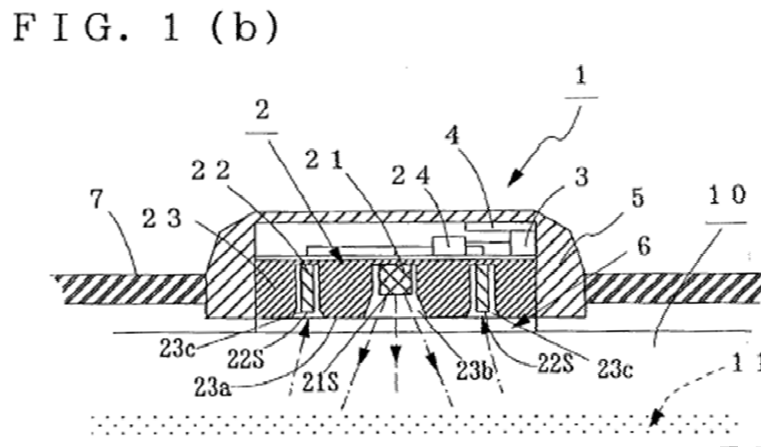


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* ¶ 23. Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an “unshown display.” *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.* ¶ 23.

Aizawa discloses that LED 21 and photodetectors 22 “are stored in cavities 23b and 23c formed in the detection face 23a” of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a “is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a.” *Id.* ¶ 24. Aizawa discloses that “a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side).” *Id.* ¶ 26. Furthermore, “the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.” *Id.* ¶¶ 26, 34.

## 2. Overview of Mendelson-2003 (Ex. 1024)

Mendelson-2003 is a journal article titled “Measurement Site and Photodetector Size Considerations in Optimizing Power Consumption of a Wearable Reflectance Pulse Oximeter,” which discusses a pulse oximeter sensor in which “battery longevity could be extended considerably by

employing a wide annularly shaped photodetector ring configuration and performing SpO<sub>2</sub> measurements from the forehead region.” Ex. 1024, 3016.<sup>2</sup>

Mendelson-2003 explains that pulse oximetry uses sensors to monitor oxygen saturation (SpO<sub>2</sub>), where the sensor typically includes light emitting diodes (LED) and a silicon photodetector (PD). *Id.* According to Mendelson-2003, when designing a pulse oximeter, it is important to offer “low power management without compromising signal quality.” *Id.* at 3017. “However, high brightness LEDs commonly used in pulse oximeters require[] relatively high current pulses, typically in the range between 100–200mA. Thus, minimizing the drive currents supplied to the LEDs would contribute considerably toward the overall power saving in the design of a more efficient pulse oximeter.” To achieve this goal, Mendelson-2003 discusses previous studies in which

the driving currents supplied to the LEDs . . . could be lowered significantly without compromising the quality of the [photoplethysmographic signal] by increasing the overall size of the PD . . . . Hence, by maximizing the light collected by the sensor, a very low power-consuming sensor could be developed, thereby extending the overall battery life of a pulse oximeter intended for telemedicine applications.

*Id.*

Mendelson-2003 discloses the prototype of such a sensor in Figure 1, which is reproduced below, and served as the basis for the studies evaluated in Mendelson-2003.

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<sup>2</sup> Petitioner cites to the native page numbers appearing at the top of Exhibit 1024, rather than the added page numbering at the bottom of the pages. We follow Petitioner’s numbering scheme.

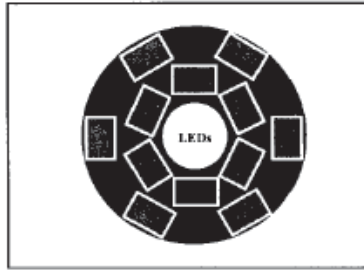


Figure 1 of Mendelson-2003 depicts a sensor configuration showing the relative positions of its PDs and LEDs. *Id.* As shown in Figure 1, “six PDs were positioned in a close inner-ring configuration at a radial distance of 6.0mm from the LEDs. The second set of six PDs spaced equally along an outer-ring, separated from the LEDs by a radius of 10.0mm.” *Id.* Mendelson-2003 also explains that “[e]ach cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” *Id.*

Mendelson-2003 reports the results of the studies as follows:

Despite the noticeable differences between the PPG signals measured from the wrist and forehead, the data plotted in Fig. 3 also revealed that considerable stronger PPGs could be obtained by widening the active area of the PD which helps to collect a bigger proportion of backscattered light intensity. The additional increase, however, depends on the area and relative position of the PD with respect to the LEDs. For example, utilizing the outer-ring configuration, the overall increase in the average amplitudes of the R and IR PPGs measured from the forehead region was 23% and 40%, respectively. Similarly, the same increase in PD area produced an increase in the PPG signals measured from the wrist, but with a proportional higher increase of 42% and 73%.

*Id.* at 3019.

### 3. Overview of Ohsaki (Ex. 1014)

Ohsaki is a U.S. patent application publication titled “Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User’s Wrist,” and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1014, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

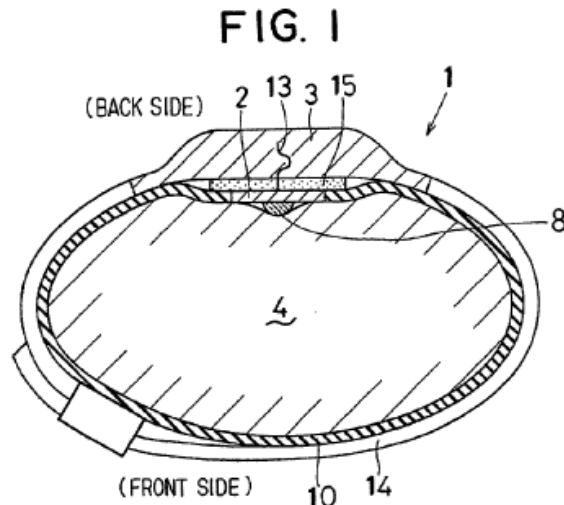


Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

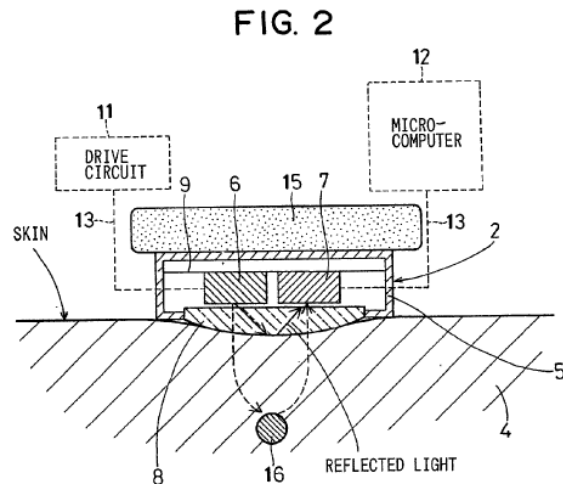


Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

“[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. “[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user’s skin,” preventing detecting element 2 from slipping off the detecting position of the user’s wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses “variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user’s skin.” *Id.* Additionally, the convex surface prevents penetration by “noise such as disturbance light from the outside.” *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* “The monitor display shows the calculated pulse rate.” *Id.*

#### 4. *Goldsmith (Ex. 1027)*

Goldsmith is a U.S. patent application publication titled “Watch Controller for a Medical Device,” and discloses a watch controller device

that communicates with an infusion device to “provid[e] convenient monitoring and control of the infusion pump device.” Ex. 1027, code (57).

Goldsmith’s Figure 9A is reproduced below.

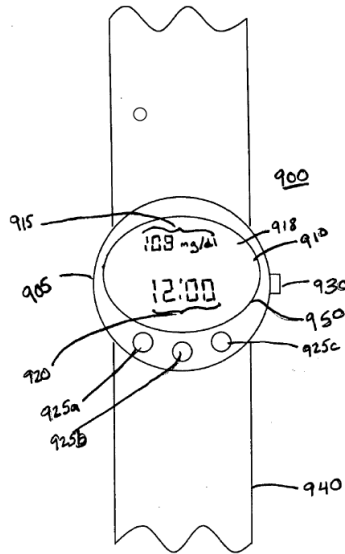


FIG. 9A

Figure 9A is a front view of a combined watch and controller device. *Id.* ¶ 30. As shown in Figure 9A, watch controller 900 includes housing 905, transparent member 950, display 910, rear-side cover 960, input devices 925a–c, 930, and wrist band 940. *Id.* ¶¶ 85–86, Fig. 9B.

Goldsmith discloses that the watch controller may interact with one or more devices, such as infusion pumps or analyte monitors. *Id.* ¶ 85; *see also id.* ¶ 88 (“The analyte sensing device 1060 may be adapted to receive data from a sensor, such as a transcutaneous sensor.”). Display 910 “may display at least a portion of whatever information and/or graph is being displayed on the infusion device display or on the analyte monitor display,” such as, e.g., levels of glucose. *Id.* ¶ 86. Additionally, the watch controller may communicate with a remote station, e.g., a computer, to allow data downloading. *Id.* ¶ 89 (including wireless).

### 5. *Independent Claim 1*

Petitioner presents undisputed contentions that claim 1 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith. Pet. 6–85.

*i. “A user-worn physiological measurement device that defines a plurality of optical paths, the physiological measurement device comprising”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses a pulse sensor that defines a plurality of optical paths, and that Goldsmith teaches an analyte sensor that is part of a user-worn controller device that includes, e.g., a display.<sup>3</sup> Pet. 36–37; *see, e.g.*, Ex. 1006 ¶¶ 2 (“a pulse wave sensor for detecting the pulse wave of a subject”), 27 (discussing optical paths), Fig. 1(b) (depicting two optical paths from emitter 21 to detectors 22 in Aizawa’s sensor); Ex. 1027 ¶¶ 85 (“a watch”), 88 (“analyte sensing device 1060”), Fig. 9A.

Petitioner further contends that a person of ordinary skill in the art would have found it obvious to incorporate Aizawa’s sensor “into Goldsmith’s integrated wrist-worn watch controller device that includes, among other features, a touch screen, network interface, and storage device” in order to receive and display data sensed by Aizawa’s sensor. Pet. 30–31; *see, e.g.*, Ex. 1003 ¶¶ 88–89. Petitioner contends this is consistent with Aizawa’s disclosure of a transmitter that transmits pulse rate data to a display. Pet. 29; Ex. 1003 ¶ 86. According to Petitioner, this would have

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<sup>3</sup> Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble’s subject matter is satisfied by the prior art.



“enable[d] a user to view and interact with heart rate data during exercise via the Goldsmith’s touch-screen display, and to enable heart rate data to be monitored by the user and/or others through any of the devices with which Goldsmith’s device can communicate.” Pet. 31; *see, e.g.*, Ex. 1003 ¶ 90. Petitioner asserts this would have been use of a known technique to improve similar devices in the same way. Pet. 32; *see, e.g.*, Ex. 1003 ¶ 91; *see also* Pet. 32–35 (also discussing physical incorporation); *see, e.g.*, Ex. 1003 ¶¶ 92–94 (same).

Patent Owner does not dispute this contention. *See* PO Resp. 65 (arguing only that Goldsmith does not remedy purported deficiencies, discussed *infra* at §§ II.D.5.iii–v). We are persuaded by Petitioner, wherein the proposed modification is supported by the un rebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 86–96; Ex. 1006 ¶¶ 23 (“a transmitter for transmitting the above pulse rate data to an unshown display”), 35.

*ii. “[a] one or more emitters configured to emit light into tissue of a user”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses LED 21 that emits light into a user’s tissue. Pet. 37–38; *see, e.g.*, Ex. 1006 ¶ 23 (“LED 21 . . . for emitting light having a wavelength of a near infrared range”), 27 (explaining that light is emitted toward the wrist), Fig. 1(b) (depicting emitter 21 facing user tissue 10).

*iii. “[b] a first set of photodiodes positioned on a first surface and surrounded by a wall that is operably connected to the first surface, wherein: [c] the first set of photodiodes comprises at least four photodiodes” and “[e] a second set of photodiodes positioned on the first surface and surrounded by the wall, wherein: [f] the*

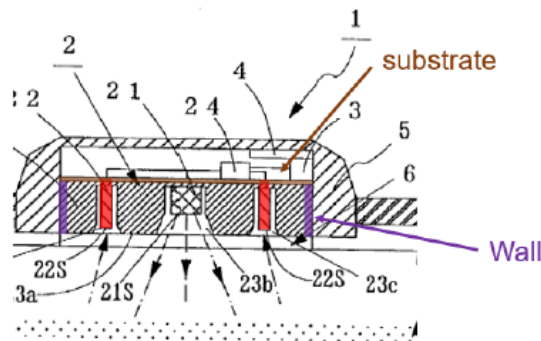
*second set of photodiodes comprises at least four photodiodes”*

### Petitioner’s Undisputed Contentions

Petitioner contends that Aizawa discloses a first set of four photodiodes that are circularly arranged around a central emitter. Pet. 16–17 (citing, e.g., Ex. 1006 ¶ 23). Petitioner also contends that, in one embodiment, Aizawa discloses that eight or more detectors may be used to improve detection efficiency, but does not expressly teach a “second set of photodiodes,” as claimed. *Id.* at 17–18 (citing, e.g., Ex. 1006, Fig. 4(a)); *see also* Ex. 1003 ¶¶ 68–70.

Patent Owner does not dispute these contentions, and we agree with Petitioner. Aizawa discloses a set of “four phototransistors 22” that are disposed in a single ring around central emitter 21. Ex. 1006 ¶ 23, Figs. 1(a)–1(b). Aizawa also discloses that “the number of the photodetectors 22 may be increased” to further improve detection efficiency, and depicts in Figure 4(a) an embodiment where eight photodetectors 22 are disposed in a single ring around central emitter 21. *Id.* ¶ 32.

Petitioner also contends that Aizawa’s first set of photodiodes are positioned on the sensor’s first surface and surrounded by a wall that is operably connected to the surface, as shown below. Pet. 39.



Petitioner's modified and annotated figure depicts Aizawa's sensor with Aizawa's first set of photodiodes 22 (in red shading) positioned on a first surface (identified as "substrate" with brown shading) and surrounded by a wall (identified as "wall" with purple shading). Patent Owner does not dispute these contentions, and we agree with Petitioner. Ex. 1006, Fig. 1(b).

Moreover, according to Petitioner, Mendelson-2003 teaches a sensor that uses two rings of photodiodes, which improve light collection efficiency, permit use of lower brightness LEDs, and reduce power consumption. Pet. 19; *see also* Ex. 1003 ¶ 71.

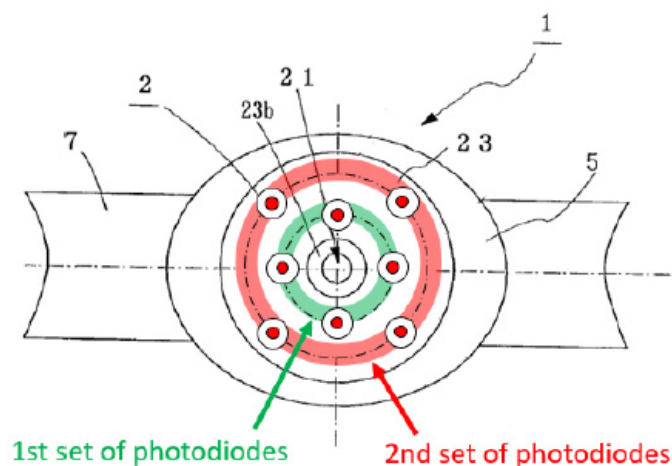
Patent Owner does not dispute these contentions regarding what Mendelson-2003 discloses, and we agree with Petitioner. Mendelson-2003 teaches an experimental sensor in which "six PDs [(photodetectors)] were positioned in a close inner-ring configuration . . . [and a] second set of six PDs [were] spaced equally along an outer-ring." Ex. 1024, 3017, Fig. 1 (depicting a prototype sensor with a near ring of photodetectors and a far ring of photodetectors). Based on experiments using the dual-ring sensor, as compared to sensors using only a near ring or only a far ring, Mendelson-2003 states that "considerabl[y] stronger PPGs [photoplethysmographic signals] could be obtained by widening the active area of the PD which helps to collect a bigger proportion of backscattered light intensity." *Id.* at 3019, Fig. 3. Mendelson-2003 also states that, "by combining both PD sets to simulate a single large PD area, it is possible to further reduce the driving currents of the LEDs without compromising the amplitude or quality of the detected PPGs." *Id.* at 3019, Fig. 4. Finally, Mendelson-2003 teaches that estimated battery life for the dual-ring sensor, as compared to sensors using only a near ring or only a far ring, "could be extended considerably." *Id.* at

3019, Table 1 (battery life of 52.5 days for the dual-ring sensor, compared to 45.8 and 20.3 days for the near ring or far ring sensors, respectively).

Petitioner's Disputed Contentions

In view of these teachings, Petitioner contends that a person of ordinary skill in the art would have found it obvious to modify Aizawa to include an additional ring of detectors, as taught by Mendelson-2003, (i.e., a “second set”) to “advance[e] Aizawa’s goal of improving detection efficiency through increased power savings.” Pet. 18–19 (citing, e.g., Ex. 1003 ¶ 70), 38–41 (citing, e.g., Ex. 1003 ¶¶ 98–103), 46–48 (citing, e.g., Ex. 1003 ¶¶ 110–112). According to Petitioner, “by using Mendelson-2003’s power-saving (and thus efficiency-enhancing) PD configuration, the power consumption of a wrist-based pulse sensing device as in Aizawa can be reduced through use of a less bright and, hence, lower power-consuming LED.” *Id.* at 20–21 (citing, e.g., Ex. 1003 ¶ 73).

Petitioner provides “[a]n example implementation of adding an additional ring of detectors to Aizawa, as per Mendelson-2003,” which is reproduced below.



Pet. 21 (citing, e.g., Ex. 1003 ¶ 74). Petitioner’s modified and annotated figure depicts Aizawa’s sensor with Aizawa’s first set of photodiodes

(depicted as connected by a green ring) and modified to include a second set of photodiodes as taught by Mendelson-2003 (depicted as connected by a red ring). Pet. 21, 41, 48. Petitioner contends this would have been the use of a known solution to improve similar systems in the same way, which “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor,” especially where Aizawa itself discloses adding extra detectors to improve light collection efficiency. *Id.* at 22 (citing, e.g., Ex. 1003 ¶ 76).

Petitioner also contends that, as modified, the second set of photodiodes would be positioned on the sensor’s first surface and surrounded by a wall that is operably connected to the surface. Pet. 47 (citing, e.g., Ex. 1003 ¶ 111).

#### Patent Owner’s Arguments

Patent Owner’s arguments address limitations [b]–[g] together. *See* PO Resp. 54–64. As such, Patent Owner’s arguments, the parties’ Reply and Sur-reply briefing, and our analyses, are presented below in connection with limitations [d] and [g]. *See infra* § II.D.5.iv.

- iv. “[d] the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream”*  
*and*  
*“[g] the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream”*

#### Petitioner’s Undisputed Contentions

Petitioner contends that a signal stream is sent from Aizawa’s set of photodetectors 23 to drive detection circuit 24, which amplifies the outputs of the photodetectors. Pet. 17 (citing, e.g., Ex. 1006 ¶ 23; Ex. 1003 ¶ 68).

Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that “drive detection circuit 24 [is] for detecting a pulse wave by amplifying the outputs of the photodetectors 22.” Ex. 1006 ¶ 23.

Petitioner additionally contends that Mendelson-2003 teaches that each set of photodiodes, i.e., its near ring and far ring, are wired in parallel, thereby providing a distinct signal stream for each ring. Pet. 19, 42–43, 48 (citing, e.g., Ex. 1024, 3017).

Patent Owner does not dispute this contention regarding what Mendelson-2003 discloses, and we agree with Petitioner. Mendelson-2003 teaches that “[e]ach cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” Ex. 1024, 3017.

#### Petitioner’s Disputed Contentions

In view of these teachings, Petitioner contends that a person of ordinary skill in the art “would have recognized and/or found it obvious that the first set of photodiodes [in the modified system of Aizawa and Mendelson-2003, *see supra* § II.D.5.iv] are connected to one another in parallel to provide a first signal stream in the manner claimed,” and “the second set of photodiodes . . . are connected to one another in parallel to provide a second signal stream,” as taught by Mendelson-2003. Pet. 40–41 (citing, e.g., Ex. 1003 ¶¶ 104–109), 48 (citing, e.g., Ex. 1003 ¶ 113). Petitioner contends this “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor.” *Id.* at 22 (citing, e.g., Ex. 1003 ¶ 76).

According to Petitioner, this arrangement would have provided known benefits. Pet. 43–46. For example, Petitioner contends that a person of ordinary skill in the art “would have known that connecting multiple photodiodes together in parallel allows the current generated by the multiple photodiodes in [each] set/ring to be added to one another, thereby resulting in a larger total current akin to what would be generated from a single, large detector.” *Id.* at 42. According to Petitioner, this was “a routine and conventional design choice.” *Id.* at 43. Further, “monitoring each signal stream (from each ring of detectors) separately allows the system to determine when the sensor device is so severely located that its position should be adjusted,” and can help detect motion artifacts. *Id.* at 43–44 (citing Ex. 1003 ¶ 107).

Petitioner also argues that a person of skill in the art would have known that “the photodiodes in the far ring (i.e., second set of photodiodes) would receive reflected light having a lower intensity than that received by the photodiodes in the near ring (i.e., first set of photodiodes) and would have been motivated and found it obvious to account for this discrepancy,” e.g., by “keep[ing] each ring separately wired and connected to its own amplifier . . . to thereby keep the magnitude of the current signals provided by each ring approximately the same before being combined and transmitted to the arithmetic circuit 3.” *Id.* at 44–46 (citing Ex. 1003 ¶¶ 108–109); *id.* at 48 (citing Ex. 1003 ¶ 113).

#### Patent Owner’s Arguments

Patent Owner disputes Petitioner’s contentions that it would have been obvious (1) to modify Aizawa to include a second set of at least four photodiodes, and (2) to wire the photodiodes of the first set in parallel to

provide a first signal stream and to wire the photodiodes of the second set in parallel to provide a second signal stream. PO Resp. 54–64; PO Sur-reply 23–29.

First, Patent Owner argues this proposed modification changes Aizawa’s principle of operation. Specifically, Patent Owner claims that “Aizawa’s approach monitors different individual detector signals and calculates pulse rate based on each individual photodetector signal” and, in contrast to the proposed modification, “does not measure aggregated signals from detectors connected in parallel.” PO Resp. 55 (citing Ex. 1006 ¶¶ 7, 19, 23, 27–29, 32, 36; Ex. 2004 ¶ 102; Ex. 2026, 76:13–22, 79:22–80:3). According to Patent Owner, the proposed modification “eliminates Aizawa’s *core feature*—the ability to monitor pulse using the output of each *individual* detector, which Aizawa indicates avoids displacement problems.” *Id.* at 56–57 (citing, e.g., Ex. 2004 ¶¶ 104–105).

Second, Patent Owner argues this proposed modification would have resulted in increased power consumption. *Id.* at 57. According to Patent Owner, Mendelson-2003 states that its power savings is caused by “increasing the *number of detectors* and thus the detector area, not the two-ring structure.” *Id.* at 58 (citing Ex. 1024, 2; Ex. 2004 ¶ 106). Moreover, Patent Owner argues that Aizawa already discloses a way to improve detection efficiency—by including eight detectors in a single ring. *Id.* at 58 (citing Ex. 1006 ¶ 32, Fig. 4A; Ex. 2004 ¶ 107). In light of this teaching, Patent Owner argues that adding a second ring is unfounded and unnecessary, especially where the second ring of detectors “would receive substantially lower light intensity requiring greater power consumption to utilize than additional detectors added to the ‘inner’ ring.” *Id.* at 58–60



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(citing, e.g., Ex. 2004 ¶¶ 108–109; Ex. 2026, 55:7–17, 56:6–16, 59:14–60:7, 100:6–101:6, 102:5–17, 112:3–16). “Petitioner never explains why, given these straightforward options to increase signal strength, a [person of ordinary skill in the art] would instead add an entire new circle of detectors farther from the emitter.” *Id.* at 60.

Third, Patent Owner argues that Mendelson-2003 provides only an experimental detector configuration, which would fail to provide the alleged benefits. Specifically, Patent Owner argues that Mendelson-2003 “uses its particular configuration for specific experiments comparing light intensity and LED drive currents for detectors arranged different distances from central emitters,” and “teaches no benefits for this arrangement in practice.” *Id.* at 60–62 (citing Ex. 1024, 4; Ex. 2004 ¶¶ 111–112). To the contrary, Patent Owner alleges that Mendelson-2003 actually prefers a single detector ring that outputs a single signal stream: “Mendelson 2003 explains it ‘combin[ed] both PD sets to simulate *a single* large PD area,’ and notes ‘battery longevity could be extended considerably by employing *a* wide annular PD,’ which has a single signal stream—not two different signal streams from two different parallel-connected rings.” *Id.* at 61 (citing, e.g., Ex. 2026, 87:8–88:1, 91:15–92:7).<sup>4</sup> Thus, according to Patent Owner, even

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<sup>4</sup> Patent Owner also criticizes the Petition’s discussion of Exhibit 1025 (U.S. Patent No. 6,801,799 (“Mendelson ’799”). Mendelson ’799, which is not included in Petitioner’s identification of the asserted ground of unpatentability. PO Resp. 62–63; PO Sur-reply 28–29. We discern no error in Petitioner’s identification of Mendelson ’799. The nature of Petitioner’s reliance on Mendelson ’799 in support of this ground is explained clearly in the Petition, even if Mendelson ’799 is not listed as an additional reference in the identification of the ground. Thus, the Petition complies with 35 U.S.C. § 312(a)(3) (stating an IPR petition must “identif[y], in writing and

if a skilled artisan would have added a second ring of detectors to Aizawa, they “would not have kept the first and second ring of detectors separate or separately amplified the aggregated signals”; instead, they would have “combin[ed] both PD sets to simulate a single large PD area,” where “battery longevity could be extended considerably by employing a wide annular PD.” *Id.* at 64 (quoting Ex. 1024, 4; citing Ex. 2004 ¶ 116).

Finally, Patent Owner argues that the proposed combination “introduces signal processing problems requiring a further redesign for Aizawa’s sensor” to include a second amplifier to account for signals of different strengths between the near and far rings. *Id.* at 63–64 (citing Ex. 2004 ¶ 115). Patent Owner alleges this demonstrates that a skilled artisan would not have added a second ring of detectors, as proposed, but instead would have increased the number of detectors in Aizawa’s single ring. *Id.* at 64.

#### Petitioner’s Reply

Petitioner replies that Patent Owner mischaracterizes Aizawa’s principle of operation. Pet. Reply 32–34. Specifically, Petitioner contends that Aizawa’s detector ring is connected in parallel, or at least that a person of ordinary skill in the art would have recognized that parallel connection would have been a known implementation detail, which allows a signal to be detected even if one of the multiple sensors is displaced on the user. *Id.* at 33 (citing Ex. 1003 ¶¶ 105–106; Ex. 1060 ¶ 62; Ex. 2026, 72:3–9). Moreover, Petitioner argues that Aizawa lacks any disclosure of individually monitoring signals from each photodetector. *Id.* at 34.

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with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge . . .”).

Petitioner reiterates its position that adding a second ring would collect a bigger portion of backscattered light, and would motivate the proposed combination. *Id.* at 34–35 (citing, e.g., Ex. 1060 ¶¶ 64–66). Petitioner also disputes that such a modification would increase power, noting that it is the emitters, not the detectors, that consume most power in the system. *Id.* at 35–36 (citing, e.g., Ex. 1060 ¶ 67). Moreover, Petitioner contends that by widening the detection area with a second ring, the system would capture additional light which would allow a lower brightness, and lower power, emitter to be used. *Id.*

Petitioner disputes Patent Owner’s characterization of Mendelson-2003’s as purely experimental, and alleges that Mendelson-2003 makes clear that employing two rings outputting two signal streams is equivalent to employing a wider single ring of detectors, and provides associated benefits. *Id.* at 36–38 (citing, e.g., Ex. 1060 ¶ 70).

#### Patent Owner’s Sur-reply

Patent Owner reiterates its position that Aizawa concerns individual monitoring, which Patent Owner alleges is a “key feature of Aizawa’s sensor,” in order to avoid problems associated with sensor displacement. PO Sur-reply 23–24. Patent Owner also reiterates its positions that the proposed modified sensor would consume more power, and that Aizawa’s disclosed embodiment with eight detectors in a single ring would have been preferred. *Id.* at 25.

#### Analysis

We have considered the parties’ arguments and cited evidence, and we are persuaded by Petitioner’s contentions. As discussed above, Aizawa discloses a sensor with a first set of four phototransistors 22 as claimed,

which are disposed in a single ring around central emitter 21. Ex. 1006 ¶ 23, Figs. 1(a)–1(b). Mendelson-2003 teaches a sensor with a dual-ring configuration, where a first inner ring includes six photodetectors, and a second outer ring includes an additional six photodetectors. Ex. 1024, 3017, Fig. 1. Mendelson-2003 also states that by using this dual-ring configuration to simulate a wide photodetector area, stronger signals could be obtained, drive currents could be reduced, and battery life could be extended. *Id.* at 3019, Fig. 3, Fig. 4.

In light of these explicit teachings, we are persuaded by Petitioner’s contention that a person of ordinary skill in the art would have found it obvious to include a second set of detectors in Aizawa’s sensor, as taught by Mendelson-2003, to realize the benefits taught by Mendelson-2003, i.e., stronger signals with reduced power consumption. Pet. 18–22. We credit Dr. Kenny’s testimony that this would have been the use of a known solution—a sensor with dual detector rings as taught by Mendelson-2003—to improve similar systems—Aizawa’s sensor with one detector ring—in the same way, which “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor,” especially where Aizawa itself discloses adding extra detectors to improve light collection efficiency. Ex. 1003 ¶ 76.

We also credit Dr. Kenny’s testimony that, as taught by Mendelson-2003, it would have been obvious to connect the photodetectors of each set in parallel to provide first and second signal streams, respectively, and that this would have led to predictable results. Ex. 1003 ¶ 76 (predictable), 93, 104–106 (first set), 113 (second set). Indeed, the two rings taught by Mendelson-2003 are disclosed as being “wired in parallel and connected

through a central hub to the common summing input of a current-to-voltage converter.” Ex. 1024, 3017. Dr. Kenny explains numerous advantages associated the parallel connections taught by Mendelson-2003, such as monitoring for displacement, accounting for motion artifacts, and compensating for the relative decrease in light that reaches the outer ring, which cannot be achieved with a single signal stream. Ex. 1003 ¶¶ 107–109.

We are also persuaded by Petitioner that, as modified, the second set of photodiodes would be positioned on the sensor’s first surface and surrounded by a wall that is operably connected to the surface, in the same manner as the first set are arranged. Pet. 37, 47; Ex. 1003 ¶¶ 99–102, 110–111.

We have considered Patent Owner’s arguments but find them to be misplaced. First, we do not agree that Aizawa discloses the ability to individually monitor individual detectors as a “key feature” (PO Resp. 54; PO Sur-reply 24) of its sensor. We discern no persuasive support for this position in Aizawa. Aizawa does not discuss individual monitoring at all, at least not clearly, and does not discuss individual monitoring as a solution to sensor displacement. Rather, Aizawa explains that its sensor includes four photodetectors 22 and that “reflected light is detected by the plurality of photodetectors 22.” Ex. 1006 ¶¶ 23, 27. Aizawa also explains that its sensor includes a “drive detection circuit for detecting a pulse wave by amplifying the outputs of the photodetectors 22.” *Id.* ¶ 23. These disclosures indicate that Aizawa does not monitor each photodetector 22 individually to ascertain the pulse wave but, rather, utilizes “the outputs” of *all* of the photodetectors together.

This understanding is consistent with Aizawa's disclosure of sensor displacement. As Patent Owner correctly notes, Aizawa recognizes a problem with sensor displacement, in which "no output signal can be obtained" if the sensor's detectors are placed away from an artery. *Id.* ¶ 7. Aizawa solves this problem by avoiding a "linear[]" detector arrangement, such that "[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately." *Id.* ¶ 9. Indeed, Aizawa is clear that, in its preferred embodiment, it is the disposition of photodetectors 22 in "a circle concentric to the light emitting diode 21" that enables accurate pulse detection even when the sensor is dislocated. *Id.* ¶ 27. Aizawa does not discuss individual monitoring in relation to sensor dislocation.

We have examined Patent Owner's alleged support for the importance of individual monitoring and find it unavailing. *See, e.g.*, PO Resp. 55–56 (citing Ex. 1006 ¶¶ 7, 19, 23, 27–29, 32, 36; Ex. 2004 ¶ 102; Ex. 2026, 76:13–22, 79:22–80:3). Patent Owner identifies Figure 3, which depicts a "diagram of a pulse wave which is the output of *a photodetector*." Ex. 1006 ¶¶ 19 (emphasis added), 28 ("the above photodetector 22"). Patent Owner seems to place importance on the use of the article "a" or "the" photodetector, in the singular. PO Resp. 88; PO Sur-reply 23. However, we discern no significance in the singular use. In discussing this Figure, Aizawa does not discuss monitoring an individual photodetector, or describe that as a "key feature"; instead, Aizawa explains that drive detection circuit 24 amplifies the detected pulse wave and transmits it to arithmetic circuit 3, which compares it to a threshold value to calculate a pulse rate. Ex. 1006 ¶ 28. We discern that this discussion of how the circuits process a signal from "a" (or "the") photodetector is merely exemplary of the process; Patent

Owner has not pointed to any persuasive support for its position that this somehow indicates a “key feature” of Aizawa is individual monitoring. As noted above, Aizawa plainly discloses that it is the signals from *the plurality* of photodetectors that is used to determine a pulse wave. *Id.* ¶¶ 23, 27. Nothing in Figure 3 or paragraph 28 clearly contradicts that disclosure.

We have considered the cited testimony of Dr. Madisetti, which Patent Owner relies upon as support for its position, but we find it unavailing as well. Dr. Madisetti’s testimony includes the same citations presented by Patent Owner, none of which demonstrates individual monitoring. Ex. 2004 ¶ 102. Thus, we determine this testimony to be conclusory and entitled to little weight.

We do recognize, as did Dr. Kenny during his deposition, that Aizawa does not provide extensive discussion of the algorithms through which Aizawa determines a pulse wave. *See, e.g.*, Ex. 2026, 80:8–18 (“It doesn’t describe the algorithm in detail. It just says amplifies the signals from the detectors and then performs whatever function takes place inside the arithmetic circuit which I think computes the number of times the signal crosses the threshold value to calculate the pulse rate, but there’s not a clearly described precise algorithm for what goes on. It’s left for one of ordinary skill in the art to process the waveforms and, and count the crossings of the threshold and determine the pulse rate.”). Nonetheless, we decline Patent Owner’s invitation to import into Aizawa’s disclosure a “key feature” of individual monitoring that is not identified by Aizawa with any reasonable clarity. Again, as noted above, Dr. Madisetti provides no further support for the conclusory position advanced by Patent Owner.

By contrast, we credit Dr. Kenny’s testimony, which is consistent with Aizawa’s express disclosure of detecting a pulse wave from “the plurality of photodetectors” (Ex. 1006 ¶ 27), that:

connecting multiple photodetectors together in parallel allows the current generated by the multiple photodetectors to be added to one another, which would subsequently ensure that even if one of multiple sensors connected in parallel were to be displaced so as to receive no signal, the fact that all the sensors are connected in parallel such that their signals are summed means that a signal will still be detected, in accordance with Aizawa’s objective.

Ex. 1060 ¶ 62. Moreover, we agree with Dr. Kenny that “there is no disclosure anywhere in Aizawa to suggest that it is even capable of somehow monitoring the signals of each photodetector, and there is certainly no need to do so if its sensors are connected in parallel.” *Id.* Thus, considering the express disclosure of Aizawa and the competing testimony of the parties’ experts, we credit that of Dr. Kenny.

Patent Owner’s second argument—that the proposed modification would have resulted in increased power consumption—is plainly contradicted by Mendelson-2003’s disclosure. Table 1 of Mendelson-2003 is reproduced below.

**Table 1.** Comparison of estimated battery life for different PD configurations. Values based on forehead measurements for a typical 220mAh coin size battery.

PD CONFIGURATION	BATTERY LIFE [Days]
Near	45.8
Far	20.3
Near+Far	52.5

Table 1 includes three rows, each associating a different photodetector configuration with an estimated battery life. Ex. 1024, 3019. The table indicates that a configuration consisting of only a near ring of photodetectors



results in 45.8 days of battery life; a configuration consisting of only a far ring of photodetectors results in 20.3 days of battery life; and a configuration consisting of both a near ring and a far ring of photodetectors results in 52.5 days of battery life. *Id.* In describing this table, Mendelson-2003 states, “the considerable differences in the estimated power consumptions clearly points out the practical advantage gained by using a reflection sensor comprising a large ring-shaped PD area to perform SpO<sub>2</sub> measurements,” which in this case, was realized by the combination of a near and far ring of detectors, akin to the modification proposed by Petitioner. *Id.* Thus, we do not agree with Patent Owner’s argument that power consumption would increase if a second ring of detectors were added to Aizawa’s sensor; Mendelson-2003 plainly suggests the opposite and supports Petitioner’s contention that the proposed modification would result in a power savings over a single ring.

We also do not agree with the argument that a person of ordinary skill in the art would not make the proposed modification because Aizawa already discloses a way to improve detection efficiency, e.g., by including more detectors in a single ring. PO Resp. 58 (citing Ex. 1006 ¶ 32, Fig. 4A; Ex. 2004 ¶ 107). Aizawa explains that the photodetector arrangement of its single-ring preferred embodiment “is not limited” and suggests, “[f]or example,” that “the number of photodetectors 22 may be increased.” Ex. 1006 ¶ 32. Aizawa does not limit the increase in photodetectors to being included in only the existing single ring of detectors, i.e., the first set. Nothing in this disclosure teaches against adding a second set, as proposed by Petitioner for the well-supported reasons identified in Mendelson-2003 and further discussed by Dr. Kenny.

Patent Owner’s third argument—that Mendelson-2003 is experimental and would not provide the alleged benefits—likewise fails. Patent Owner’s suggestion that Mendelson-2003 teaches using a single large, wide detector ring that outputs a single signal stream is unfounded. The analysis provided in Mendelson-2003 explicitly compares a dual-ring arrangement to both a single near ring and a single far ring. *See, e.g.*, Ex. 1024, Fig. 3, Fig. 4, Table 1 (all comparing near, far, and near + far arrangements). Mendelson-2003 explains that the dual-ring arrangement “simulate[s] a single large PD area” and realizes benefits in LED power requirements. *Id.* at 3019. That Mendelson-2003 *simulates* a single ring by using two discrete rings demonstrates the fallacy of Patent Owner’s argument.

Finally, we disagree with Patent Owner’s argument that a person of ordinary skill in the art would not have made the proposed combination because it “introduces signal processing problems requiring a further redesign for Aizawa’s sensor” to include a second amplifier to account for signals of different strengths between the near and far rings. PO Resp. 63–64. A person of ordinary skill in the art must be presumed to understand something about the art beyond what is disclosed in the references. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962). After all, “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007). Neither Patent Owner nor Dr. Madisetti assert that adding a second amplifier would be beyond the level of skill in the art or would introduce any specific problems, beyond its mere addition. We credit Dr. Kenny’s testimony that a person of ordinary skill would have recognized that, in order to account for the disparate currents generated by the two rings, the rings would be separately wired with

separate amplifiers (Ex. 1003 ¶ 109) and that this would have been a routine and conventional design choice, within the level of ordinary skill in the art (*id.* ¶ 106).

For the foregoing reasons, we are persuaded by Petitioner’s contentions.

*v. “[h] a cover located above the wall and comprising a single protruding convex surface configured to be located between tissue of the user and the first and second sets of photodiodes when the physiological measurement device is worn by the user”*

#### Petitioner’s Undisputed Contentions

Petitioner contends that Aizawa “teaches a light permeable cover in the form of an acrylic transparent plate 6 . . . that is mounted at the detection face 23a” of the sensor, i.e., between the user’s tissue and Aizawa’s photodetectors, to provide “improved adhesion between the detector and the wrist to ‘further improv[e] the detection efficiency of a pulse wave.’”

Pet. 8–9 (citing Ex. 1006 ¶ 30, Fig. 1(b); Ex. 1003 ¶¶ 53–54). Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that “acrylic transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to the wrist 10.” Ex. 1006 ¶ 34, Fig. 1(b) (depicting transparent plate 6 between sensor 2 and wrist 10).

Petitioner also contends that Ohsaki teaches a wrist-worn sensor that includes a “translucent board” having a single protruding convex surface that contacts the user’s skin. Pet. 12, 49. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 includes detecting element 2 and sensor body 3, and is “worn on the back side of the user’s wrist.” Ex. 1014 ¶ 16. Ohsaki discloses that detecting

element 2 includes package 5 and “translucent board 8[,which] is a glass board which is transparent to light, [and is] attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. As seen in Ohsaki’s Figure 2, translucent board 8 has a protruding convex surface, and is located between the user’s tissue and Ohsaki’s detecting element. *Id.* ¶ 17 (“The translucent board 8 is . . . attached to the opening of the package 5.”), Fig. 2.

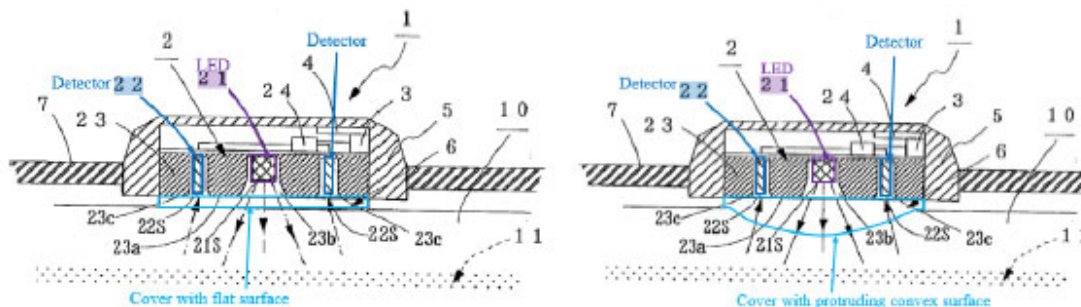
#### Petitioner’s Disputed Contentions

Petitioner further contends that a person of ordinary skill in the art would have found it obvious “to modify the sensor’s flat cover [in Aizawa] . . . to include a lens/protrusion . . . similar to Ohsaki’s translucent board 8, so as to [1] improve adhesion between the user’s wrist and the sensor’s surface, [2] improve detection efficiency, and [3] protect the elements within sensor housing.” Pet. 25 (citing, e.g., Ex. 1003 ¶ 80; Ex. 1014 ¶ 25), 49 (citing, e.g., Ex. 1003 ¶ 114). Petitioner contends that Ohsaki’s convex surface is in “intimate contact” with the user’s tissue, which prevents slippage of the sensor and increases signal strength because “variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed” and because “disturbance light from the outside” is prevented from penetrating board 8, as compared to a sensor with a flat surface. *Id.* at 23–24 (citing, e.g., Ex. 1003 ¶¶ 78–79; quoting Ex. 1014 ¶¶ 15, 17, 25).

Petitioner contends this modification would have been “nothing more than the use of a known technique to improve similar devices in the same way,” i.e., “simply improving Aizawa-Mendelson-2003’s transparent plate 6 that has a flat surface to improve adhesion to a subject’s skin and reduce variation in the signals detected by the sensor.” Pet. 26 (citing Ex. 1003

¶ 81). Further according to Petitioner, “the elements of the combined system would each perform functions they had been known to perform prior to the combination—Aizawa-Mendelson-2003’s transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki.” *Id.*

To illustrate its proposed modification, Petitioner includes two annotated versions of Aizawa’s Figure 1(b), both of which are reproduced below. Pet. 26.



Petitioner’s annotated figure on the left depicts Aizawa’s sensor with a “Cover with flat surface”; Petitioner’s annotated figure on the right depicts Aizawa’s sensor with a “Cover with protruding convex surface” (both illustrated with blue outline). Petitioner contends that, in the combination, the convex surface is above the wall provided by the holder and between the tissue of the user and the photodiodes. Pet. 49 (citing, e.g., Ex. 1003 ¶ 114)

Petitioner also identifies Japanese Patent Application 2006-296564 to Inokawa (Ex. 1007 (Japanese language); Ex. 1008 (English language translation)), which Petitioner contends “provides an additional motivation and rationale . . . to modify Aizawa to include a cover comprising a protruding convex surface.” Pet. 27. According to Petitioner, Inokawa teaches a convex lens that “increase[s] the light-gathering ability of the LED.” *Id.* (citing Ex. 1008 ¶ 15, Fig. 2. Petitioner contends that, in view of

Inokawa, a person of ordinary skill in the art would have understood how to implement Ohsaki's convex surface in Aizawa. *Id.* at 27–28 (citing Ex. 1003 ¶¶ 82–84).

#### Patent Owner's Arguments

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Aizawa's sensor to include Ohsaki's convex cover. PO Resp. 21–53;<sup>5</sup> PO Sur-reply 3–22.

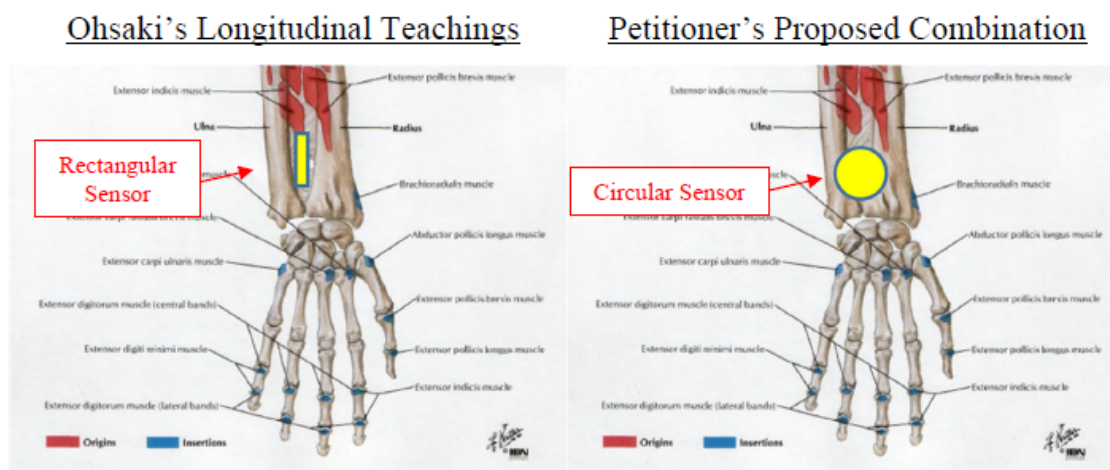
First, Patent Owner argues that the proposed modification “fundamentally changes Ohsaki's structure and eliminates the longitudinal shape that gives Ohsaki's translucent board the ability to prevent slipping.” PO Resp. 23. This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 23–26 (citing, e.g., Ex. 2004 ¶¶ 53–57; Ex. 1014 ¶¶ 6, 19, 23, 24). According to Patent Owner, Ohsaki teaches that “aligning the sensor's longitudinal direction with the circumferential

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<sup>5</sup> As an initial matter, Patent Owner observes that Petitioner “[r]eli[es] on a non-ground reference, Inokawa,” as providing the rationale for the proposed modification of Aizawa in view of Ohsaki, and as providing implementation details of the combination. RO Resp. 22 (citing Pet. 28); *id.* at 44–45, 50–53. We discern no error in Petitioner's identification of Inokawa. The nature of Petitioner's reliance on Inokawa in support of this ground is explained clearly in the Petition, even if Inokawa is not listed as an additional reference in the identification of the ground. Thus, the Petition complies with 35 U.S.C. § 312(a)(3) (stating an IPR petition must “identif[y], in writing and with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge”).

direction of the user's arm undesirably results in 'a tendency [for Ohsaki's sensor] to slip off.'" *Id.* at 25–26 (citing Ex. 1014 ¶ 19).

Thus, Patent Owner contends that Petitioner's proposed modification would "chang[e] Ohsaki's longitudinal detecting element and rectangular board into a circular shape[, which] would eliminate the advantages discussed above" because a circular shape "cannot be placed in *any longitudinal* direction and thus cannot coincide with the longitudinal direction of the user's wrist." *Id.* at 26 (citing Ex. 2004 ¶¶ 57–58). Patent Owner presents annotated Figures depicting what it contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below. *Id.* at 27.



Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated Figure on the right depicts a circular sensor placed across a user's radius and ulna. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus cannot avoid the undesirable interaction with the user's bone structure," such that a skilled artisan would have understood such a change would eliminate

Ohsaki's benefit of preventing slipping. *Id.* at 29 (citing, e.g., Ex. 2004 ¶¶ 57–58), 29 (citing Ex. 2004 ¶¶ 55–62).<sup>6</sup>

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Aizawa's sensor. PO Resp. 32. Specifically, Patent Owner argues that Aizawa's sensor must be worn on the palm side of the wrist, close to radial and ulnar arteries, which is the side opposite from where Ohsaki's sensor is worn. *Id.* at 32–38 (citing, e.g., Ex. 2004 ¶¶ 67–74). According to Patent Owner, Ohsaki teaches that the sensor's convex surface has a tendency to slip when placed on the palm side of the wrist, i.e., in the location taught by Aizawa. *Id.* at 38–41 (citing, e.g., Ex. 1014 ¶¶ 19, 23, 24; Ex. 2004 ¶¶ 75–81). Thus, Patent Owner argues that a person of ordinary skill in the art “would not have been motivated to use Ohsaki's longitudinal board—designed to be worn on the **back side** of a user's wrist—with Aizawa's **palm-side** sensor.” *Id.* at 41. Similarly, Patent Owner argues that Aizawa teaches away from the proposed modification because Aizawa teaches that its flat acrylic plate improves adhesion on the palm side of the wrist, while Ohsaki teaches that its convex board “has a tendency to slip” on the palm side of the wrist. *Id.* at 41–44 (citing, e.g., Ex. 2004 ¶¶ 82–85).

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<sup>6</sup> Patent Owner further argues, “[t]o the extent Petitioner contends a [person of ordinary skill in the art] would use Ohsaki's rectangular board on Aizawa's circular sensor . . . this argument is unsupported and incorrect.” PO Resp. 30. We do not read the Petition as making such a contention. We understand Petitioner to propose, in essence, changing Aizawa's circular *flat* cover into a circular *convex* cover. *See, e.g.,* Pet. 25.



Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Aizawa's peripheral detectors because the convex cover would condense light toward the center and away from Aizawa's detectors, which would decrease signal strength. PO Resp. 44–52 (citing, e.g., Ex. 2004 ¶¶ 86–97). Patent Owner also contends that Petitioner and Dr. Kenny admitted as much in a related proceeding. *Id.* at 45–46 (citing, e.g., Ex. 2019, 45; Ex. 2020, 69–70). Patent Owner also relies on Figure 14B of the '195 patent to support its position. *Id.* at 46–47 (citing Ex. 1001, 36:3–6, 36:13–15). Additionally, Patent Owner argues that its position is also supported by Inokawa, which also uses a convex lens to direct light toward the center but, in Inokawa's structure, the light is directed from peripheral emitters toward a central detector. *Id.* at 50–52 (citing, e.g., Ex. 1008 ¶¶ 15, 58). In light of the foregoing, Patent Owner argues that a person of ordinary skill in the art would have understood that the proposed modification would have decreased signal strength by directing light away from Aizawa's peripheral detectors. *Id.* at 52.

Fourth and finally, Patent Owner argues that a person of ordinary skill in the art “would have understood that Aizawa's *flat* plate would provide better protection than a convex surface” because it “would be less prone to scratches.” *Id.* at 52–53 (citing Ex. 1008 ¶ 106; Ex. 2004 ¶¶ 98–99).

#### Petitioner's Reply

Concerning Patent Owner's first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve

the disclosed benefits. Pet. Reply 13–20 (citing, e.g., Ex. 1060 ¶¶ 18–30). Moreover, Petitioner asserts that “[e]ven if Ohsaki’s translucent board 8 were understood to be rectangular, obviousness does not require ‘bodily incorporation’ of features from one reference into another”; rather, a person of ordinary skill in the art “would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the benefits” taught by Ohsaki. *Id.* at 16 (citing, e.g., Ex. 1060 ¶ 23). Similarly, regarding the location of the sensor, Petitioner asserts,

[E]ven assuming for the sake of argument that a [person of ordinary skill in the art] would have understood Aizawa’s sensor as being limited to placement on the backside of the wrist, and would have understood Ohsaki’s sensor’s “tendency to slip” when arranged on the front side as informing consideration of Ohsaki’s teachings with respect to Aizawa, that **would have further motivated** the [person of ordinary skill in the art] to implement a light permeable convex cover in Aizawa’s sensor, to improve detection efficiency of that sensor when placed on the palm side.

*Id.* at 18 (citing, e.g., Ex. 1060 ¶ 27). In other words, Ohsaki’s disclosure that a convex surface suppresses variation in reflected light would have motivated an artisan to add such a surface to Aizawa to improve detection efficiency of that sensor when placed on the palm side. *Id.* at 18–20.

Moreover, Petitioner replies that the proposed convex surface “would provide an additional adhesive effect that would reduce the tendency of that plate to slip, since it is well-understood that physically digging into the skin with a protrusion provides an additional adhesive effect.” *Id.* at 20 (citing Ex. 1060 ¶ 30).

Concerning Patent Owner’s third argument, Petitioner responds that Patent Owner’s argument about a convex cover directing light to the center

is belied by Ohsaki itself, which uses a convex cover over a non-centrally located detector. *Id.* (citing Ex. 1060 ¶ 31); *id.* at 30–31. According to Petitioner, Ohsaki demonstrates that even if a convex cover decreased signal strength (which it disputes), the additional benefit of reduced slippage would have been recognized by a skilled artisan. *Id.*

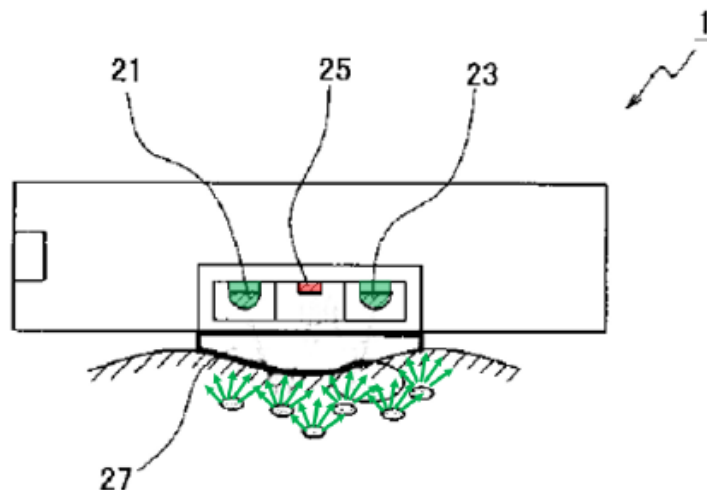
Further, Petitioner responds that adding a convex cover to Aizawa’s sensor would not decrease signal strength but, instead, “would improve Aizawa’s signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa’s photodetectors than would have with a flat cover” because such a cover improves light concentration across the entire lens and does not direct it only towards the center. Pet. 21–22 (citing, e.g., Ex. 1060 ¶¶ 31–34).

Petitioner asserts that Patent Owner and Dr. Madisetti “ignore[] the well-known optical principle of reversibility,” by which “a ray going from P to S will trace the same route as one from S to P” such that “rays that are not completely absorbed by user tissue will propagate in a reversible manner.” Pet. Reply 23 (quoting Ex. 1061, 92; citing, e.g., Ex. 1061, 87–92; Ex. 1062, 106–111; Ex. 1060 ¶ 35). When applied to Aizawa’s sensor, Petitioner contends that any condensing benefit achieved by a convex cover would thus direct emitted light toward Aizawa’s peripheral detectors. *Id.* at 23–25 (citing, e.g., Ex. 1060 ¶¶ 35–45). Petitioner explains that this principle of reversibility is recognized in Aizawa. *Id.* at 25 (citing, e.g., Ex. 1060 ¶¶ 41–44; citing Ex. 1006 ¶ 33).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue will be scattered and diffuse and will approach the detectors “from various random directions and

angles.” Pet. Reply 25–27 (citing, e.g., Ex. 1023, 52, 86, 90; Ex. 1056, 803; Ex. 1060 ¶¶ 46–49; Ex. 2006, 163:12–164:2). This scattered and diffuse light, according to Petitioner, means that Ohsaki’s convex cover cannot focus light to the center of the sensor device, as Patent Owner argues. *Id.* at 26. Instead, due to the random nature of this scattered light, Petitioner asserts that a person of ordinary skill in the art would have understood that “Ohsaki’s convex cover provides a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.” *Id.* at 30 (citing, e.g., Ex. 1060 ¶¶ 48–49). Petitioner applies this understanding to Aizawa, and asserts that using a cover with a convex protrusion in Aizawa would “enable backscattered light to be detected within a circular active detection area surrounding” a central light source. *Id.* at 26.

Petitioner relies upon the following illustration of this alleged effect. Pet. Reply 29–30 (citing Ex. 1060 ¶¶ 54–55).



APPLE-1061, 141 (annotated)

The above illustration depicts backscattered light reflecting off user tissue and toward a convex board from various angles. *Id.* at 29. According to Petitioner, “[t]his pattern of incoming light cannot be focused by a convex lens towards any single location,” and, instead, “light rays that otherwise would have missed the active detection area are instead directed toward that area” as they pass through the interface provided by the convex cover. *Id.* at 29–30.

Finally, Petitioner dismisses Patent Owner’s reliance on Figure 14B of the ’195 patent because it “is not a representation of light that has been reflected from a tissue measurement site. The light rays (1420) shown in FIG. 14B are collimated (i.e., parallel to one another), and each light ray’s path is perpendicular to the detecting surface.” Pet. Reply 27–29 (citing, e.g., Ex. 1060 ¶¶ 51–53).

Concerning Patent Owner’s fourth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the “known advantages of applying Ohsaki’s teachings,” and would not negate a motivation to combine. *Id.* at 32 (citing, e.g., Ex. 1060 ¶ 60). Moreover, Petitioner argues that “by choosing a suitable material of the protrusion to be scratch-resistant, [] it would have been obvious for a [person of ordinary skill in the art] to achieve both benefits (light gathering and scratch-resistance) at once.” *Id.*  
Patent Owner’s Sur-reply

Concerning Patent Owner’s first and second arguments, Patent Owner reiterates its position that Ohsaki’s purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist,

and that “even small changes in its sensor’s orientation or body location result in ‘a tendency to slip.’” PO Sur-reply 3–14, 6.

Concerning Patent Owner’s third argument, Patent Owner asserts that Petitioner’s Reply improperly presents several new theories as compared with the Petition. *Id.* at 16 (regarding reversibility), 19 (regarding refraction).

Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 15. Moreover, Patent Owner argues that Petitioner’s discussion of the principle of reversibility is “irrelevant” because “Petitioner never explains how the principle of reversibility could apply to such ‘random’ scattered and absorbed light” as is present when light interacts with user tissue. *Id.* at 16. The random nature of backscattered light, in Patent Owner’s view, “hardly supports Petitioner’s argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed,” and is irrelevant to the central issue presented here of “whether changing Aizawa’s flat surface to a convex surface results in more light on Aizawa’s peripherally located detectors.” *Id.* at 17.

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner’s position, which is not that a cover with a convex protrusion “focuses *all* light to a single point” at the center of the sensor as Petitioner characterizes it. PO Sur-reply 19. Patent Owner’s position, rather, is that Petitioner has not shown that a person of ordinary skill in the art “would have been motivated to change Aizawa’s flat surface to a convex surface to improve signal strength.” *Id.* In Patent Owner’s view, by arguing that the convex cover provides only a “slight refracting effect,” Petitioner

undermines its contention that providing such a cover would have improved detection efficiency. *Id.*

Moreover, Patent Owner argues that Petitioner’s theory regarding the “slight refracting effect” of a convex protrusion is “unavailing because it fails to consider the greater *decrease* in light at the detectors due to light redirection to a *more* central location.” *Id.* According to Patent Owner, any light redirected from the sensor’s edge could not make up for the loss of signal strength from light redirected away from the detectors and toward the center. *Id.* at 20.

Concerning Patent Owner’s fourth argument, Patent Owner argues that Petitioner does not dispute Patent Owner’s position that a flat cover would be less prone to scratches and offers “*no* plausible advantages for its asserted combination.” *Id.* at 22. Moreover, Patent Owner argues that “the risk of scratches undermines Petitioner’s argument that a [person of ordinary skill in the art] would have been motivated to add a convex cover to ‘protect the elements within the sensor housing.’” *Id.*

#### Analysis

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have modified Aizawa’s flat cover to include a protruding convex surface, such as that taught by Ohsaki, to (1) improve adhesion between the sensor and the user’s tissue, (2) improve detection efficiency, and (3) protect the elements within the sensor housing. Pet. 24–25. We conclude all three rationales are supported by the evidence, as follows.

#### Rationales 1 and 2

The evidence of record persuades us that adding a single protruding convex surface, such as that taught by Ohsaki, to Aizawa's cover would have improved adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.* Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1014 ¶ 25 (emphases added); *see also id.* ¶ 27 (“stably fixed”).

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Aizawa to improve that similar device in the same way, i.e., to “simply improv[e] Aizawa-Mendelson-2003's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor.” *See, e.g.,* Ex. 1003 ¶ 81; *id.* ¶¶ 78 (“[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor.”), 78–79. We also credit Dr. Kenny's testimony that, in light of these teachings, a person of ordinary skill in the art would have



made such a modification to improve the pulse sensor's ability to emit light into, and detect light reflected from, the user's wrist, to generate an improved pulse signal. Ex. 1003 ¶¶ 77–81; Ex. 1060 ¶¶ 11–13, 29.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1014, Figs. 4A–4B, ¶¶ 15, 25 (stating that with “a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4,” and with “a convex surface like the present embodiment, the variation of the amount of the reflected light” collected by the sensor “is suppressed”). Ohsaki also states that, with a convex surface, “[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.” *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the skill level of an ordinary artisan. For example, Dr. Kenny testifies:

[A person of ordinary skill in the art] would have combined the teachings of Aizawa-Mendelson-2003 and Ohsaki as doing so would have amounted to nothing more than the use of a known technique to improve similar devices in the same way. For instance, a [person of ordinary skill in the art] would have recognized that incorporating Ohsaki's convex surface is simply improving Aizawa-Mendelson-2003's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor. Furthermore, the elements of the combined system would each perform similar functions they had been known to perform prior to the combination. That is, Aizawa-Mendelson-2003's transparent plate 6 would remain in the same position,

performing the same function, but with a convex surface as taught by Ohsaki.

Ex. 1003 ¶ 81. In light of Ohsaki’s express disclosure of the benefits of a convex cover, we credit Dr. Kenny’s testimony that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner’s first through third arguments, each of which implicates Petitioner’s first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner’s first argument is premised on the notion that Ohsaki’s benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user’s forearm. PO Resp. 23–32. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1014 ¶ 17. Ohsaki’s convex surface is located on board 8, which is “attached to the opening of the package 5.” *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex protrusion.

We disagree with Patent Owner’s suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki’s Figures 1 and 2. PO Resp. 17–18. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1014 ¶ 13 (“schematic diagram”); Pet. Reply 14–15; *Hockerson-Halberstadt, Inc. v. Avia Group Int’l*, 222 F.3d 951, 956 (Fed. Cir. 2000) (“[I]t is well established that patent drawings do not define the

precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.”).

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: “[T]he length of the detecting element 2 from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side.” Ex. 1014 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user’s forearm: “[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user’s arm,” to avoid slipping off. *Id.*; see also *id.* ¶ 9 (“The light emitting element and the light receiving element are arranged in the longitudinal direction of the user’s arm.”).

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki’s convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner’s argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 13–14. We have considered the testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1060 ¶¶ 10, 12, 18–23; Ex. 2004 ¶¶ 36–39 (relying on Ohsaki’s Figures 1–2 to support the opinion that the convex surface is rectangular). Dr. Madisetti’s reliance on the dimensions of Ohsaki’s figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny’s testimony that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki’s disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user’s forearm. PO Resp. 24–26; PO Sur-reply 10 (“[A] POSITA would have understood

Ohsaki's convex board must *also* have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm."). Although Ohsaki recognizes that interaction with these bones can cause problems, (*see* Ex. 1014 ¶¶ 6, 19), we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 27, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d at 516.

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all. Moreover, even if Ohsaki's convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off

the detecting position of the user's wrist 4." Ex. 1014 ¶ 25; Ex. 1060 ¶¶ 10 ("Ohsaki does not limit its benefits to a rectangular sensor applied to a particular body location, and a [person of ordinary skill in the art] would not have understood those benefits as being so limited."), 12. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's circular-shaped sensor, to improve adhesion as taught by Ohsaki. Nothing in Ohsaki's disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1060 ¶¶ 10–23.

Moreover, Ohsaki contrasts the ability to properly receive reflected light with a convex surface as compared to a flat surface and notes that,

in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1014 ¶ 25; Ex. 1060 ¶¶ 12–13. Again, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's sensor, to improve signal strength, as taught by Ohsaki. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Aizawa and Ohsaki.

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on

the back of the user's wrist, which is the opposite side of the wrist taught by Aizawa. PO Resp. 32–44. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. *See, e.g.*, Pet. 25. In other words, Petitioner's proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki's Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when the element is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1014 ¶¶ 23–24, Figs. 3A–3B. However, we do not agree that these figures support Dr. Madiseti's conclusion that “Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different locations or orientations” such as the palm side of the wrist—particularly in comparison to a flat surface such as Aizawa's. Ex. 2004 ¶¶ 67–81. Instead, Ohsaki acknowledges that, even when the detecting element is located “on the front [palm] side of the user's wrist 4, *the pulse wave can be detected well* if the user is at rest.” Ex. 1014 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user's wrist achieves benefits. *Id.* Notably, the claims are not limited to detection during movement or exercise.

We credit, instead, Dr. Kenny's testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's sensor. *See*

Ex. 1060 ¶¶ 10–11, 15–16, 24–30. Dr. Kenny acknowledges that “certain locations present anatomical features that provide for easy measurement of large reflected light signals and other locations present anatomical features that reduce the amplitude of the reflected light signals. Because of this, a [person of ordinary skill in the art] would be motivated to search for features from other references that can provide improved adhesion, improved light gathering, reduced leakage of light from external sources, and protection of the elements within the system in order to successfully detect a pulse wave signal from many locations.” *Id.* ¶ 16. We credit Dr. Kenny’s testimony that, in light of Ohsaki’s teaching of a convex protrusion in “intimate contact with the surface of the user’s skin,” a skilled artisan would have understood that such a surface “would have increased adhesion and reduced slippage of Aizawa’s sensor when placed on either side of a user’s wrist or forearm, and additionally would have provided associated improvements in signal quality.” *Id.* ¶ 29.

Dr. Madisetti testifies that “[b]ased on Aizawa’s teaching that a flat acrylic plate improves adhesion on the palm side of the wrist, and Ohsaki’s teaching that a convex surface tends to slip on the palm side of the wrist, a [person of ordinary skill in the art] would have come to the opposite conclusion from Dr. Kenny: that modifying Aizawa’s [flat adhesive plate] ‘to include a lens/protrusion . . . similar to Ohsaki’s translucent board 8’ would not ‘improve adhesion.’” Ex. 2004 ¶ 85. We disagree with this reading of Aizawa. It is true that Aizawa’s plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate “improve[s] adhesion” (*id.* ¶ 13). Aizawa further states: “the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the

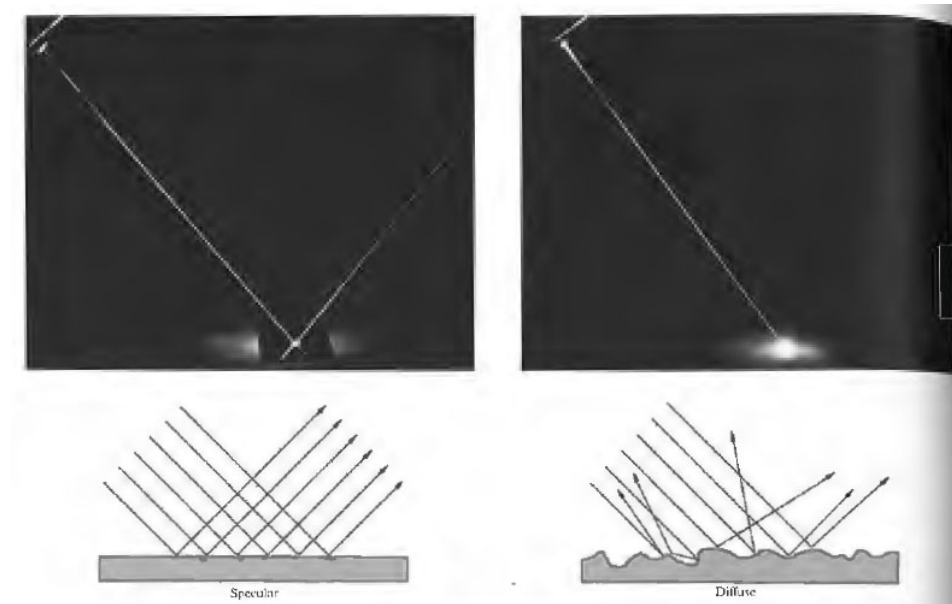
artery 11 of the wrist 10,” and “[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.” *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *Id.* ¶¶ 30, 34 (“Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved . . .”). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with. Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa’s detector to the user’s wrist.

We have considered Patent Owner’s third argument that a convex cover would condense light away from Aizawa’s peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 44–52. We disagree.

There appears to be no dispute that when emitted light passes through user tissue, the light diffuses and scatters as it travels. *See, e.g.,* Pet. Reply 25 (“[R]eflectance-type sensors work by detecting light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.’ A [person of ordinary skill in the art] would have understood that light that backscatters from the measurement site after diffusing through tissue reaches the active detection area from various random directions and angles.”) (quoting Ex. 1023, 86); PO Sur-reply 16–17 (“Petitioner admits that tissue randomly scatters and absorbs light rays, which would cause forward and reverse light paths to be unpredictable and very likely different.”).



The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner. Exhibit 1061,<sup>7</sup> Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:



This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. See Ex. 1061, 87–88 (original page numbers). The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. See *id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. See *id.*; see also Ex. 1060 ¶¶ 38–39 (discussing Ex. 1061, Figure 4.12), 46 (“A [person of ordinary skill in the art] would have understood that light that backscatters from the measurement site after

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<sup>7</sup> Eugene Hecht, *Optics* (2nd ed. 1990).

diffusing through tissue reaches the active detection area from many random directions and angles.”).

Dr. Kenny testifies that Aizawa’s sensor “detect[s] light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.’” Ex. 1060 ¶ 53 (quoting Ex. 1023, 86). Dr. Kenny further opines that a convex cover, when added to Aizawa’s sensor with multiple detectors symmetrically arranged about a central light source, allows “light rays that may have otherwise missed the detection area [to be] instead be directed toward that area as they pass through the interface provided by the cover,” thus increasing the light-gathering ability of Aizawa’s sensor. *Id.* ¶ 49.

By contrast Dr. Madisetti testifies that “a convex ‘lens/protrusion’ would direct light away from the detectors and thus result in decreased light collection and optical signal strength at the peripheral detectors” because it condenses light towards the center of the sensor and away from the peripheral detectors. Ex. 2004 ¶¶ 86–87, 90. We have considered this testimony, however, Dr. Madisetti’s opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* ¶ 89. Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 87–90; *see also id.* ¶¶ 91–97 (addressing motivation and also failing to discuss diffuse, scattered light). In other words, even if Patent Owner is correct that the ’195 patent’s Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light reflected by a user’s tissue is

scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that “Petitioner and Dr. Kenny both [previously admitted] that a convex cover condenses light towards the center of the sensor and away from the periphery,” in a different petition filed against a related patent, i.e., in IPR2020-01520. PO Resp. 45–46; Ex. 2004 ¶ 87. The cited portions of the Petition and Dr. Kenny’s declaration from IPR2020-01520 discuss a decrease in the “mean path length” of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny’s testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Aizawa’s symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. *See, e.g.*, Ex. 1060 ¶¶ 31 (“[A] cover featuring a convex protrusion would improve Aizawa’s signal-to- noise ratio by causing more light backscattered from tissue to strike Aizawa’s photodetectors than would have with a flat cover.”), 34 (“improves ‘light concentration at pretty much *all of the locations under the curvature of the lens*’”), 46 (“A [person of ordinary skill in the art] would have understood that light which backscatters from the measurement site after diffusing through tissue reaches the active detection area from various random directions and angles.”), 49 (“[L]ight rays that may have otherwise missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.”); *see generally id.* ¶¶ 31–59. We do not discern that the convergence of a

single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface.

We additionally do not agree with Patent Owner’s argument that Petitioner’s Reply presents new theories that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of, *inter alia*, increasing the light gathering ability of Aizawa’s device. *See* Pet. 25. Patent Owner’s Response then challenged that contention, with several arguments that Petitioner’s proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See* PO Resp. 44–52. This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019) (“Consolidated Guide”),<sup>8</sup> 73 (“A party also may submit rebuttal evidence in support of its reply.”). This is what Petitioner did here. The Reply does not change Petitioner’s theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 22–28, *with* Reply 20–31.

### Rationale 3

Petitioner further contends that a person of ordinary skill in the art would have recognized that a cover with a protruding convex surface, such as that taught by Ohsaki, would “protect the elements within the sensor housing” of Aizawa. Pet. 25. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would also protect the sensor’s internal

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<sup>8</sup> Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

components in a manner similar to Aizawa's flat acrylic plate. Ex. 1003 ¶ 80; Ex. 1060 ¶ 60; *see also* Ex. 1008 ¶ 15 (noting that a cover "protect[s] the LED or PD").

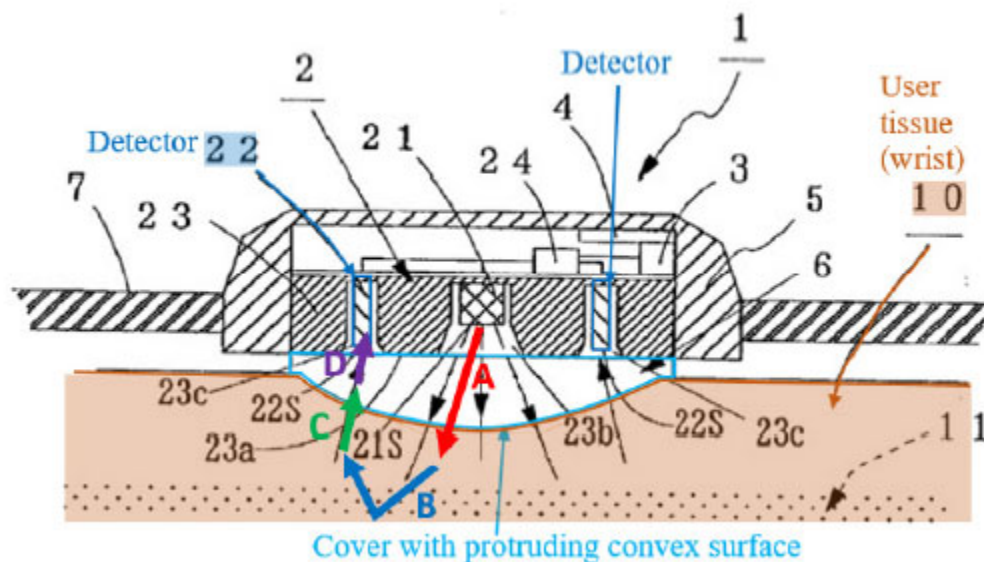
We disagree with Patent Owner's fourth argument that a person of ordinary skill in the art would not have modified Aizawa as proposed because a convex cover would be prone to scratches and because other alternatives existed. Patent Owner does not explain how the potential presence of scratches on a convex cover would preclude that cover's ability to, nonetheless, protect the internal sensor components in Aizawa, as Petitioner proposes. That a convex cover may be more prone to scratches than Aizawa's flat cover is one of numerous tradeoffs that a person of ordinary skill in the art would consider in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). Moreover, as Petitioner notes, and Patent Owner does not dispute, a scratch resistant material could be employed in fabricating the cover. Pet. Reply 32; PO Sur-reply 23. The record does not support the premise that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

*vi. "[i] wherein the physiological measurement device provides a plurality of optical paths, wherein each of the optical paths: [j] exits an emitter of the one or more emitters, [k] passes through tissue of the user, [l] passes through the single protruding convex surface, and [m] arrives at a corresponding photodiode of the at least one*

*of the first or second sets of photodiodes, the corresponding photodiode configured to receive light emitted by the emitter after traversal by the light of a corresponding optical path of the plurality of optical paths and after attenuation of the light by tissue of the user.”*

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses a plurality of optical paths that exit emitter 21, pass through tissue 10, pass through the cover’s convex surface (as modified in light of Ohsaki’s teachings), and arrive at a photodiode of the first or second set of photodiodes (as modified in light of Mendelson-2003’s teachings), wherein the photodiode receives the light that travels through the optical paths and is attenuated by the tissue, as shown in Petitioner’s modified figure below. Pet. 51.



The annotated figure depicts “different sections of one of the optical paths,” in which “the optical path (A) exits an emitter, (B) passes through the tissue of the user, (C) passes through the single protruding convex surface, and (D) arrives at a corresponding photodiode.” Pet. 51. This contention is

consistent with Aizawa's disclosure and Dr. Kenny's undisputed testimony. *See, e.g.*, Ex. 1006 ¶ 27 ("Near infrared radiation output toward the wrist 10 from the light emitting diode 21 is reflected by a red corpuscle running through the artery 11 of the wrist 10 and this reflected light is detected by the plurality of photodetectors 22 so as to detect a pulse wave (see FIG. 1(b)."), Fig. 1(b) (depicting two optical paths from emitter 21 to detectors 22 in Aizawa's sensor); Ex. 1003 ¶¶ 115–117.

*vii. Summary*

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

*6. Dependent Claims 2–15*

Petitioner contends that claims 2–15 would have been obvious based on the same combination of prior art addressed above. Claims 2–15 depend directly or indirectly from independent claim 1. Ex. 1001, 45:35–46:62.

*i. Dependent Claims 2–8 and 10–14*

Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 51–64, 66–81, 85. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 118–135, 139–162, 184–186.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1.

PO Resp. 65 (“[T]he Petition fails to establish that independent claims 1 and 16 are obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims.”); *see supra* § II.D.5.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that 2–8 and 10–14 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

*ii. Dependent Claims 9 and 15*

Dependent claim 9 ultimately depends from independent claim 1 and further recites the “protruding convex surface protrudes a height between 1 millimeter and 3 millimeters.” Ex. 1001, 46:14–16.

Dependent claim 15 ultimately depends from independent claim 1 and further recites the “protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters.” *Id.* at 46:59–62.

Petitioner contends that the sensor rendered obvious by the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith would have included a cover with a protruding convex surface. *See supra* § II.D.5.v. With respect to claim 9, Petitioner contends that a person of ordinary skill in the art “would have found it obvious that a device designed to fit on a user’s wrist would be on the order of millimeters,” consistent with Ohsaki’s disclosure that the device is in “intimate contact” with the user’s skin. Pet. 64–65 (citing, e.g., Ex. 1003 ¶¶ 136–137). Petitioner also contends that an ordinarily skilled artisan would have taken user comfort into account when establishing the dimensions of the device’s convex cover. *Id.* With



these considerations in mind, Petitioner contends that, “in order to provide a comfortable cover that prevents slippage, the convex surface should protrude a height between 1 millimeter and 3 millimeters,” because “there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable to the user.” *Id.* at 66 (citing, e.g., Ex. 1003 ¶ 138). With respect to claim 15, Petitioner incorporates its contentions regarding claim 9. Pet. 81; Ex. 1003 ¶ 163

Patent Owner argues that none of the cited references discloses the claimed height range and that Petitioner relies on hindsight reconstruction. PO Resp. 66 (citing, e.g., Ex. 2004 ¶¶ 120–125). Patent Owner also characterizes Dr. Kenny’s testimony as conclusory and unsupported. *Id.* at 68–69.

Petitioner is correct that, when “there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense.” *KSR*, 550 U.S. at 402. Petitioner has shown sufficiently that only a finite number of solutions existed with respect to the height of a convex protrusion on a tissue-facing sensor, which would have met the art-recognized goals of both (1) intimate contact between the sensor’s surface and the user and (2) user comfort. *See, e.g.*, Ex. 1014 ¶¶ 6, 25. Bearing in mind these considerations, we credit Dr. Kenny’s testimony that it would have been obvious, “in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, [that] the

surface should protrude a height between 1 millimeter and 3 millimeters,” as recited in claim 13, and which further includes the claimed range of 2 to 3 millimeters as recited in claim 17. Ex. 1003 ¶ 138. Further, the record does not support that any new and unexpected results were achieved at the claimed height greater than 2 millimeters and less than 3 millimeters. *See, e.g.,* Ex. 1001, 23:43–50 (“The height 430 can be from about 0.5 millimeters to about 3 millimeters, e.g., about 2 millimeters. In an embodiment, the dimensions 400, 410, and 430 can be selected such that the measurement site contact area 470 includes an area of about 80 square millimeters, although larger and smaller areas can be used for different sized tissue for an adult, an adolescent, or infant, or for other considerations.”).

We have considered Patent Owner’s argument, and Dr. Madisetti’s cited testimony. However, it is not dispositive that none of the cited references teaches the claimed range. PO Resp. 66; Ex. 2004 ¶ 121. Petitioner relies upon the knowledge, ability, and creativity of a person of ordinary skill in the art, not the teachings of a specific reference. Notably, Dr. Madisetti does not dispute Dr. Kenny’s position that there were a finite number of options available for the height of the convex surface. Ex. 2004 ¶¶ 121–125. Therefore, we do not agree that Petitioner’s contentions are rooted in impermissible hindsight. *See, e.g., In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) (“Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.”).

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 9 and 15 would have been obvious over the cited combination of references.

### 7. *Claims 16 and 17*

Independent claim 16 includes limitations [a]–[h] and includes additional limitations drawn to “a plurality of windows,” “preprocessing electronics,” “one or more processors,” a “network interface,” a “touch-screen display,” and “storage device,” a “strap,” and “a plurality of optical paths.” Ex. 1001 46:63–48:39. Dependent claim 17 depends directly from claim 16 and further recites a “handheld computing device . . . .” *Id.* at 48:40–44.

In asserting that claim 16 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith, Petitioner refers to the contentions made regarding claim 1, as well as claims depending therefrom. *See* Pet. 81–84. Regarding claim 17, Petitioner refers to the contentions made regarding, *inter alia*, claim 10. *Id.* at 86. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 164–186.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 11–65 (addressing claims 1 and 16 together with respect to Petitioner’s first ground and stating, “the Petition fails to establish that independent claims 1 and 16 are obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims”); *see supra* § II.D.5.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 16 and 17 would have been obvious over the cited combination of references. *See supra* II.D.5; Ex. 1003 ¶¶ 164–186.

*E. Obviousness over the Combined Teachings of  
Aizawa, Mendelson-2003, Ohsaki, Goldsmith, and Ali*

Petitioner provides arguments and evidence, including the Kenny Declaration, in support of Petitioner’s additional ground challenging claims 1–17 of the ’195 patent. Pet. 86–89; Ex. 1003 ¶¶ 187–191. Because we have already determined that those claims are unpatentable based on Aizawa, Mendelson-2003, Ohsaki, and Goldsmith, which is dispositive as to all challenged claims, we need not reach this additional ground. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. 2020) (“[T]he Board need not address issues that are not necessary to the resolution of the proceeding.”).

### III. CONCLUSION

In summary, we determine that a preponderance of the evidence establishes claims 1–17 of the '195 patent are unpatentable, as shown in the following table:<sup>9</sup>

<b>Claim(s)</b>	<b>35 U.S.C. §</b>	<b>References</b>	<b>Claims Shown Unpatentable</b>	<b>Claims Not Shown Unpatentable</b>
1–17	103	Aizawa, Mendelson-2003, Ohsaki, Goldsmith	1–17	
1–17	103 <sup>10</sup>	Aizawa, Mendelson-2003, Ohsaki, Goldsmith, Ali		
<b>Overall Outcome</b>			1–17	

<sup>9</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. §§ 42.8(a)(3), (b)(2).

<sup>10</sup> As explained above in Section II.E, because we conclude that claims 1–17 are unpatentable on other grounds, we do not reach the merits of this ground.

#### IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–17 of the '195 patent have been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2020-01733

Patent 10,702,195 B1

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC.,  
Petitioner,

v.

MASIMO CORPORATION,  
Patent Owner.

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IPR2020-01737  
Patent 10,709,366 B1

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Before JOSIAH C. COCKS, ROBERT L. KINDER, and  
AMANDA F. WIEKER, *Administrative Patent Judges*.

KINDER, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
*35 U.S.C. § 318(a)*



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## I. INTRODUCTION

### *A. Background*

Apple Inc. (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–27 (“challenged claims”) of U.S. Patent No. 10,709,366 B1 (Ex. 1001, “the ’366 patent”). Paper 2 (“Pet.”). Masimo Corporation (“Patent Owner”) waived filing a Preliminary Response. Paper 6. We instituted an *inter partes* review of all challenged claims 1–27 on all asserted grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 7 (“Inst. Dec.”).

After institution, Patent Owner filed a Response (Paper 15, “PO Resp.”) to the Petition, Petitioner filed a Reply (Paper 19, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 22, “Sur-reply”). An oral hearing was held on February 9, 2022, and a transcript of the hearing is included in the record. Paper 32 (“Tr.”).

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–27 of the ’366 patent are unpatentable.

### *B. Related Proceedings*

*Masimo Corporation v. Apple Inc.*, Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

*Apple Inc. v. Masimo Corporation*, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

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*Apple Inc. v. Masimo Corporation*, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims 1–29 of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01716 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

*Apple Inc. v. Masimo Corporation*, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

*Apple Inc. v. Masimo Corporation*, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2); and

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*Apple Inc. v. Masimo Corporation*, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1).  
Pet. 94–95; Paper 3, 1, 3–4.

Patent Owner further identifies certain pending patent applications, as well as other issued and abandoned applications, that claim priority to, or share a priority claim with, the '366 patent. Paper 3, 1–2.

### *C. The '366 Patent*

The '366 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on July 14, 2020, from U.S. Patent Application No. 16/829,510, filed March 25, 2020. Ex. 1001, codes (21), (22), (45), (54). The '366 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/086,060, 61/086,108, 61/086,063, 61/086,057, each filed August 4, 2008, as well as 61/091,732, filed August 25, 2008, and 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The '366 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:38–40. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:29–37, 2:62–3:12. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:42–48.

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Figure 1 of the '366 patent is reproduced below.

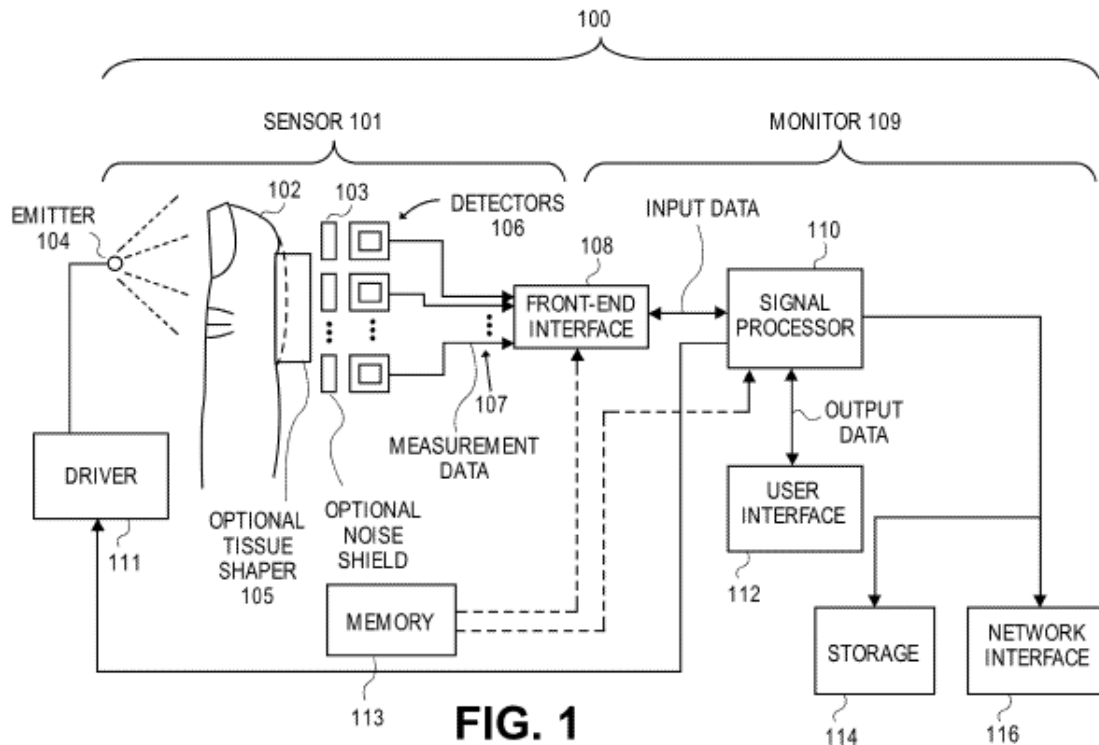


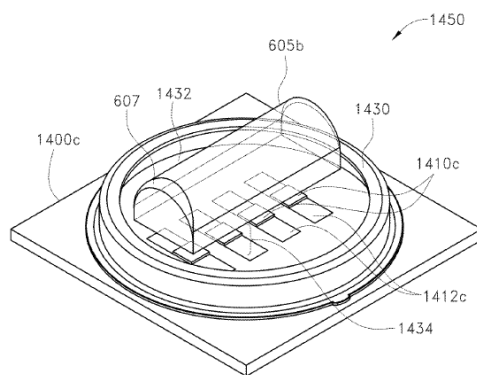
Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:51–61. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 11:61–63; 14:4–7. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* at 14:3–10. In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:7–10, 28–33. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 10:61–11:13.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:16–18. “[S]ignal processor 110 includes processing logic that

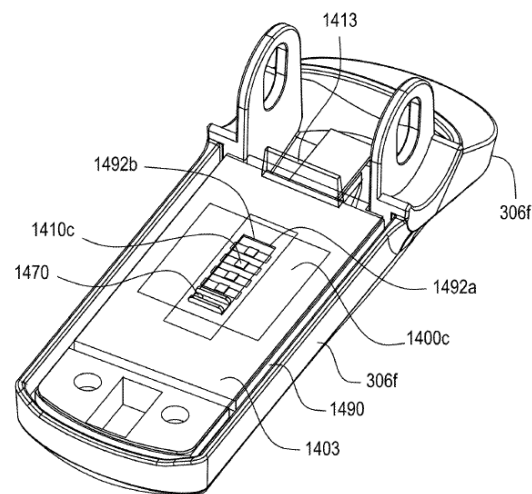
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determines measurements for desired analytes, . . . based on the signals received from the detectors 106.” *Id.* at 15:20–24. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:46–50. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:60–67.

The ’366 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate sensor devices.



**FIG. 14D**



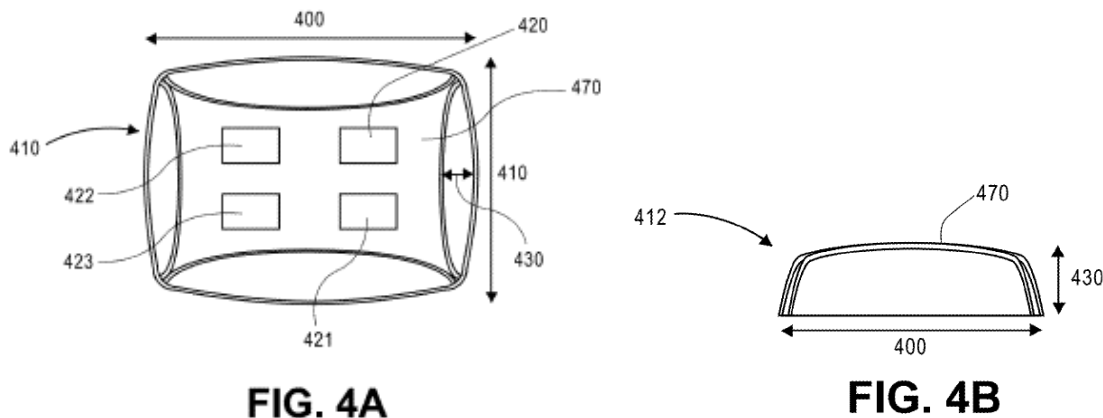
**FIG. 14F**

Figure 14D (left) illustrates portions of a detector submount and Figure 14F (right) illustrates portions of a detector shell. *Id.* at 6:44–47. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:39–43, 36:30–41. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–17. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively,

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cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–49.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.



Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:18–24. “[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site.” *Id.* “For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site.” *Id.* at 23:41–43. The measurement site contact area may include windows 420–423 that “mimic or approximately mimic a configuration of, or even house, a plurality of detectors.” *Id.* at 23:49–63.

#### *D. Illustrative Claim*

Of the challenged claims, claim 1, 14, and 27 are independent. Claim 1 is illustrative and is reproduced below.

1. A noninvasive physiological parameter measurement device adapted to be worn by a wearer, the noninvasive physiological parameter measurement device comprising:

- [a] one or more light emitters;
- [b] a substrate having a surface;

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[c] a first set of photodiodes arranged on the surface and spaced apart from each other, wherein:

[d] the first set of photodiodes comprises at least four photodiodes, and

[e] the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream responsive to light from at least one of the one or more light emitters attenuated by body tissue;

[f] a second set of photodiodes arranged on the surface and spaced apart from each other, wherein:

[g] the second set of photodiodes comprises at least four photodiodes,

[h] the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream responsive to light from at least one of the one or more light emitters attenuated by body tissue, and

[i] at least one of the first signal stream or the second signal stream includes information usable to determine a physiological parameter of a wearer of the noninvasive physiological parameter measurement device;

[j] a wall extending from the surface and configured to surround at least the first and second sets of photodiodes; and

[k] a cover arranged to cover at least a portion of the surface of the substrate, wherein the cover comprises a protrusion that extends over all of the photodiodes of the first and second sets of photodiodes arranged on the surface, and wherein the cover is further configured to cover the wall.

Ex. 1001, 44:57–45:27 (bracketed identifiers [a]–[k] added). Independent claim 14 includes limitations substantially similar to limitations [a], [c]–[h], [j], and [k] and includes additional limitations drawn to “one or more processors configured to: receive information . . . ; [and], process the information to determine physiological parameter measurement

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information.” *Id.* at 46:33–56. Independent Claim 27 contains numerous limitations, which are integrated from claim 1 (limitations [a]–[k]) as well as limitations from numerous dependent claims. *Id.* at 48:1–49:10; Pet. 81–84.

*E. Applied References*

Petitioner relies upon the following references:

Sherman et al., U.S. Patent No. 4,941,236, filed July 6, 1989, issued July 17, 1990 (Ex. 1047, “Sherman”);

Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1014, “Ohsaki”);

Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, “Aizawa”);

Goldsmith et al., U.S. Patent Application Publication No. 2007/0093786 A1, filed July 31, 2006, published April 26, 2007 (Ex. 1027, “Goldsmith”); and

Y. Mendelson, et al., “*Measurement Site and Photodetector Size Considerations in Optimizing Power Consumption of a Wearable Reflectance Pulse Oximeter*,” Proceedings of the 25th IEEE EMBS Annual International Conference, 3016-3019 (2003) (Ex. 1024, “Mendelson-2003”).

Pet. 1–2.

Petitioner also submits, *inter alia*, a Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003) and a Second Declaration of Dr. Kenny (Ex. 1060). Patent Owner submits, *inter alia*, a Declaration of Vijay K. Madiseti, Ph.D (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madiseti, including from this proceeding and others. Exs. 1053–1056, 2006–2009, 2026–2027.



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### *F. Asserted Grounds of Unpatentability*

We instituted an *inter partes* review based on the following grounds.  
Inst. Dec. 11, 33.

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–12 and 14–27	103	Aizawa, Mendelson-2003, Ohsaki, Goldsmith
13	103	Aizawa, Mendelson-2003, Ohsaki, Goldsmith, Sherman

## II. DISCUSSION

### *A. Claim Construction*

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2020). Accordingly, we construe the claims according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). Petitioner submits that no claim term requires express construction. Pet. 3. Patent Owner asserts that the claims should be given their ordinary and customary meaning, consistent with the specification. PO Resp. 9.

Based on our analysis of the issues in dispute, we conclude that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

### *B. Principles of Law*

A claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406

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(2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness.<sup>1</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

### *C. Level of Ordinary Skill in the Art*

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having “a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software

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<sup>1</sup> The parties have not presented objective evidence of non-obviousness.

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technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information.” Pet. 3 (citing Ex. 1003 ¶¶ 21–22). “Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline.” *Id.*

Patent Owner makes several observations regarding Petitioner’s identified level of skill in the art but, “[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner’s asserted level of skill.” PO Resp. 9.

We adopt Petitioner’s assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

*D. Obviousness over the Combined Teachings of  
Aizawa, Mendelson-2003, Ohsaki, and Goldsmith*

Petitioner contends that claims 1–12 and 14–27 of the ’366 patent would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith. Pet. 10–91; *see also* Pet. Reply 8–37.<sup>2</sup> Patent Owner disagrees. PO Resp. 8–66; *see also* Sur-reply 1–29.

Based on our review of the parties’ arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 1–12 and 14–27 are unpatentable.

*1. Overview of Aizawa (Ex. 1006)*

Aizawa is a U.S. patent application publication titled “Pulse Wave Sensor and Pulse Rate Detector,” and discloses a pulse wave sensor that

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<sup>2</sup> Petitioner’s Reply includes a Table of Contents and an Exhibits list that spans pages ii–vii, and the substance of the Reply then begins on page 8.

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detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

F I G . 1 ( a )

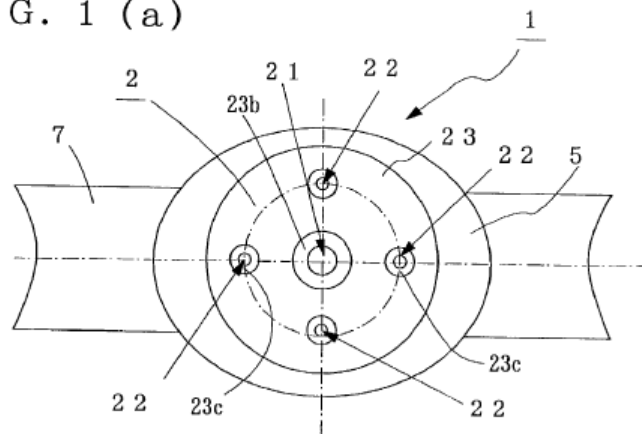


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode (“LED”) 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, “to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased.” *Id.* ¶ 32, Fig. 4(a). “The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22.” *Id.* ¶ 33.

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Figure 1(b) of Aizawa is reproduced below.

F I G . 1 ( b )

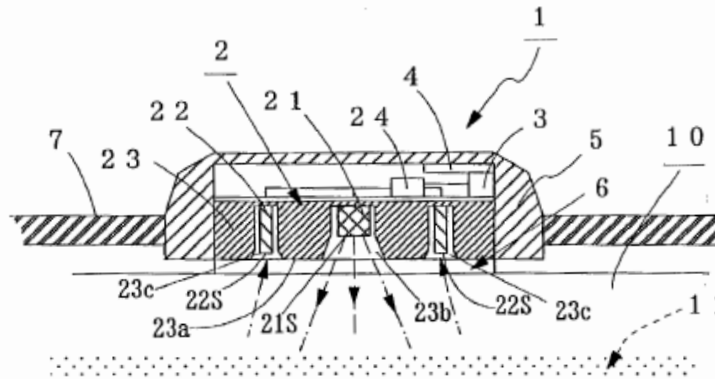


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an “unshown display.” *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.*

Aizawa discloses that LED 21 and photodetectors 22 “are stored in cavities 23b and 23c formed in the detection face 23a” of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a “is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a.” *Id.* Aizawa discloses that “a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side).”

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*Id.* ¶ 26. Furthermore, “the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.”

*Id.* ¶¶ 26, 34.

## 2. Overview of Mendelson-2003 (Ex. 1024)

Mendelson-2003 is a journal article titled “Measurement Site and Photodetector Size Considerations in Optimizing Power Consumption of a Wearable Reflectance Pulse Oximeter,” which discusses a pulse oximeter sensor in which “battery longevity could be extended considerably by employing a wide annularly shaped photodetector ring configuration and performing SpO<sub>2</sub> measurements from the forehead region.” Ex. 1024, 3016.<sup>3</sup>

Mendelson-2003 explains that pulse oximetry uses sensors to monitor oxygen saturation (SpO<sub>2</sub>), where the sensor typically includes light emitting diodes (LED) and a silicon photodetector (PD). *Id.* According to Mendelson-2003, when designing a pulse oximeter, it is important to offer “low power management without compromising signal quality.” *Id.* at 3017. “However, high brightness LEDs commonly used in pulse oximeters require[] relatively high current pulses, typically in the range between 100–200mA. Thus, minimizing the drive currents supplied to the LEDs would contribute considerably toward the overall power saving in the design of a more efficient pulse oximeter.” *Id.* To achieve this goal, Mendelson-2003 discusses previous studies in which

the driving currents supplied to the LEDs . . . could be lowered significantly without compromising the quality of the

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<sup>3</sup> We adopt Petitioner’s citation format by referring to the original page numbering and not Petitioner’s added page numbering at the bottom.

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[photoplethysmographic or PPG signals] by increasing the overall size of the PD . . . . Hence, by maximizing the light collected by the sensor, a very low power-consuming sensor could be developed, thereby extending the overall battery life of a pulse oximeter intended for telemedicine applications.

*Id.*

Mendelson-2003 discloses the prototype of such a sensor in Figure 1, which is reproduced below, and served as the basis for the studies evaluated in Mendelson-2003.

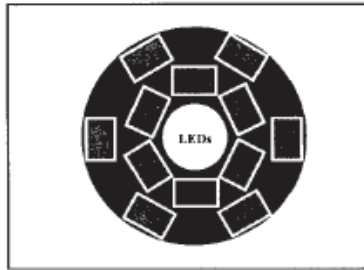


Figure 1 of Mendelson-2003 depicts a sensor configuration showing the relative positions of its PDs and LEDs. *Id.* As shown in Figure 1, “six PDs were positioned in a close inner-ring configuration at a radial distance of 6.0mm from the LEDs. The second set of six PDs spaced equally along an outer-ring, separated from the LEDs by a radius of 10.0mm.” *Id.*

Mendelson-2003 also explains that “[e]ach cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” *Id.*

Mendelson-2003 reports the results of the studies as follows:

Despite the noticeable differences between the PPG signals measured from the wrist and forehead, the data plotted in Fig. 3 also revealed that considerable stronger PPGs could be obtained by widening the active area of the PD which helps to collect a bigger proportion of backscattered light intensity. The additional increase, however, depends on the area and relative position of the PD with respect to the LEDs. For example,

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utilizing the outer-ring configuration, the overall increase in the average amplitudes of the R and IR PPGs measured from the forehead region was 23% and 40%, respectively. Similarly, the same increase in PD area produced an increase in the PPG signals measured from the wrist, but with a proportional higher increase of 42% and 73%.

*Id.* at 3019.

### 3. Overview of Ohsaki (Ex. 1014)

Ohsaki is a U.S. patent application publication titled “Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User’s Wrist,” and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1014, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

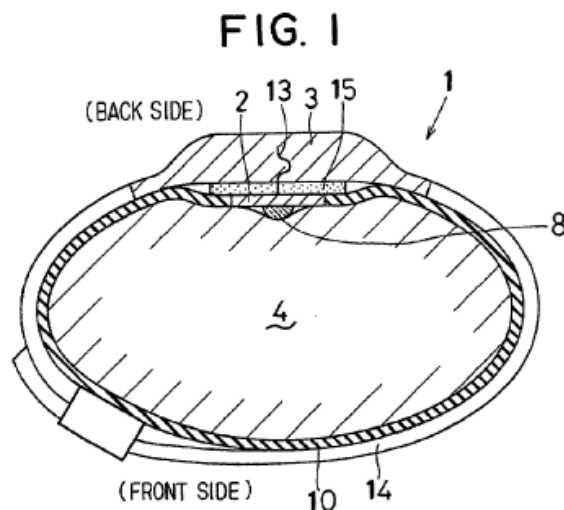


Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user’s wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.



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Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

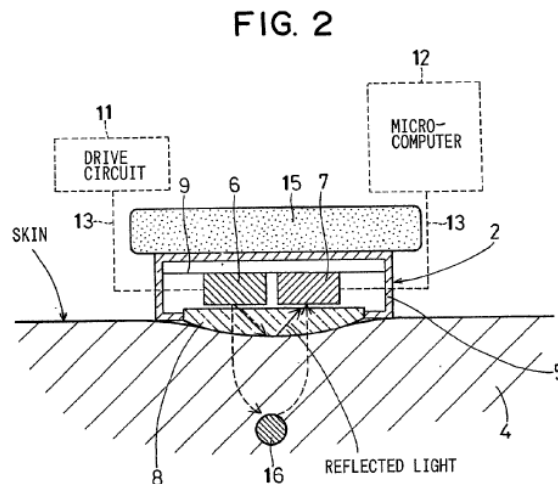


Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

“Translucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. “[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user’s skin,” preventing detecting element 2 from slipping off the detecting position of the user’s wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses “variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user’s skin.” *Id.* Additionally, the convex surface prevents penetration by “noise such as disturbance light from the outside.” *Id.*

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Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* “The monitor display shows the calculated pulse rate.” *Id.*

#### 4. Overview of Goldsmith (Ex. 1027)

Goldsmith is a U.S. patent application publication titled “Watch Controller for a Medical Device,” and discloses a watch controller device that communicates with an infusion device to “provid[e] convenient monitoring and control of the infusion pump device.” Ex. 1027, codes (54), (57).

Goldsmith’s Figure 9A and 9B are reproduced below.

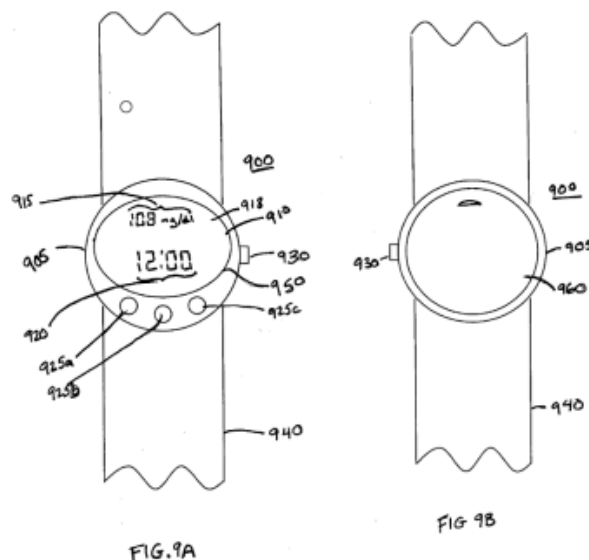


Figure 9A and Figure 9B are respective front and rear views of a combined watch and controller device. *Id.* ¶¶ 30–31. As shown in Figure 9A, watch

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controller 900 includes housing 905, transparent member 950, display 910, input devices 925a–c, scroll wheel 930, and wrist band 940. *Id.* ¶¶ 85–86. Figure 9B shows rear-side cover 960, and a rear view of housing 905, scroll wheel 930, and wrist band 940. *Id.*

Goldsmith discloses the watch controller may interact with one or more devices, such as infusion pumps or analyte monitors. *Id.* ¶ 85; *see also id.* ¶ 88 (“The analyte sensing device 1060 may be adapted to receive data from a sensor, such as a transcutaneous sensor.”). Display 910 “may display at least a portion of whatever information and/or graph is being displayed on the infusion device display or on the analyte monitor display,” such as, e.g., levels of glucose. *Id.* ¶ 86. The display is customizable in a variety of configurations including user-customizable backgrounds, languages, sounds, font (including font size), and wall papers. *Id.* ¶¶ 102, 104. Additionally, the watch controller may communicate with a remote station, e.g., a computer, to allow data downloading. *Id.* ¶ 89 (including wireless). The remote station may also include a cellular telephone to be “used as a conduit for remote monitoring and programming.” *Id.*

### 5. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith. Pet. 38–53. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties’ contentions and then provide our analysis.

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- i. *“A noninvasive physiological parameter measurement device adapted to be worn by a wearer, the noninvasive physiological parameter measurement device comprising”*

The cited evidence supports Petitioner’s undisputed contention that “Aizawa discloses a pulse sensor that is designed to ‘detect[] the pulse wave of a subject from light reflected from a red corpuscle in the artery of a wrist of the subject by irradiating the artery of the wrist,’” and that Goldsmith teaches an analyte sensor that is part of a user-worn controller device that includes, e.g., a display.<sup>4</sup> Pet. 33, 39 (quoting Ex. 1006 ¶ 2); *see also* Ex. 1006 ¶ 27 (discussing optical path), Fig. 2 (depicting physiological parameter measurement device worn by a user); Ex. 1027 ¶¶ 85 (“a watch”), 88 (“analyte sensing device 1060”), Fig. 9A; Ex. 1003 ¶ 94.

Petitioner further contends that a person of ordinary skill in the art would have found it obvious to incorporate Aizawa’s sensor “into Goldsmith’s integrated wrist-worn watch controller device that includes, among other features, a touch screen, network interface, and storage device” in order to receive and display data sensed by Aizawa’s sensor. Pet. 31–38; *see, e.g.*, Ex. 1003 ¶¶ 88–89 (“would have enhanced the sensor’s utility and improved the user’s experience”). According to Petitioner, this would have “enable[d] a user to view and interact with heart rate data during exercise via Goldsmith’s touch-screen display, and to enable heart rate data to be monitored by the user and/or others through any of the devices with which Goldsmith’s device can communicate.” Pet. 34; *see, e.g.*, Ex. 1003 ¶ 89.

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<sup>4</sup> Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently based on the final record that the recitation in the preamble is satisfied by the prior art.

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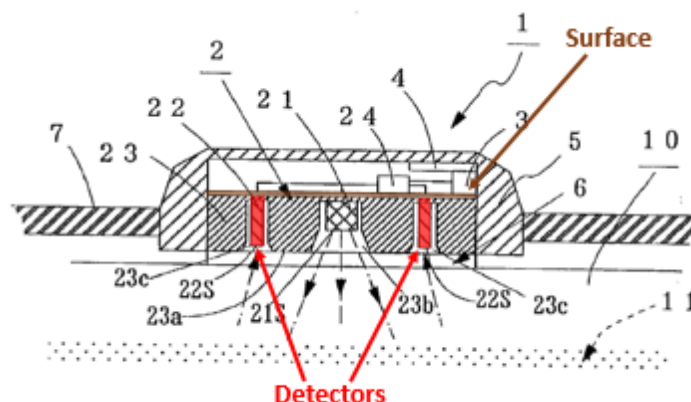
Petitioner asserts this would have been use of a known technique to improve similar devices in the same way. Pet. 35; *see, e.g.*, Ex. 1003 ¶ 90; *see also* Pet. 35–38 (also discussing physical incorporation); *see, e.g.*, Ex. 1003 ¶¶ 90–93 (same).

Petitioner’s stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 88–94.

- ii. “[a] one or more light emitters”  
and  
“[b] a substrate having a surface”

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses an emitter, LED 21, that emits light that is picked up by photodetectors. Pet. 40; *see, e.g.*, Ex. 1006 ¶ 23 (“LED 21 . . . for emitting light having a wavelength of a near infrared range”), 27 (explaining that light is emitted toward the wrist), Fig. 1(b) (depicting emitter 21 facing user tissue 10), Fig. 2 (depicting sensor worn on user’s wrist).

Petitioner persuasively demonstrates that a person of ordinary skill in the art would have understood that Aizawa’s surface would include a substrate on which the emitter and detectors are arranged. Pet. 41. Petitioner relies on annotated Figure 1(b) of Aizawa, reproduced below.



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Petitioner’s annotated Figure 1(b) shows detectors highlighted in red and a substrate surface unnumbered but highlighted in brown. Pet. 41. Dr. Kenny likewise testifies that Aizawa teaches “a substrate having surface (shown in brown) on which the holder 23 is placed and on which the detectors/photodiodes are arranged.” Ex. 1003 ¶ 96.

- iii. *“[c] a first set of photodiodes arranged on the surface and spaced apart from each other, wherein: [d] the first set of photodiodes comprises at least four photodiodes”*  
*and*  
*“[f] a second set of photodiodes arranged on the surface and spaced apart from each other, wherein: [g] the second set of photodiodes comprises at least four photodiodes”*

#### Petitioner’s Undisputed Contentions

Petitioner contends that Aizawa discloses a first set of four photodiodes that are circularly arranged around a central emitter. Pet. 18 (citing, e.g., Ex. 1006 ¶ 23). Petitioner also contends that, in one embodiment, Aizawa discloses that eight or more detectors may be used to improve detection efficiency, but does not expressly teach a “second set of photodiodes,” as claimed. *Id.* at 19–20 (citing, e.g., Ex. 1006, Fig. 4(a)); *see also* Ex. 1003 ¶¶ 67–68.

Patent Owner does not dispute these contentions, and we agree with Petitioner. Aizawa discloses a set of “four phototransistors 22” that are disposed in a single ring around central emitter 21. Ex. 1006 ¶ 23, Figs. 1(a)–1(b). Aizawa also discloses that “the number of the photodetectors 22 may be increased” to further improve detection efficiency, and depicts in Figure 4(a) an embodiment where eight photodetectors 22 are disposed in a single ring around central emitter 21. *Id.* ¶ 32.

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Also according to Petitioner, Mendelson-2003 teaches a sensor that uses two rings of photodiodes, which improve light collection efficiency, permit use of lower brightness LEDs, and reduce power consumption.

Pet. 20–21; *see also* Ex. 1003 ¶¶ 69–70.

Patent Owner does not dispute these contentions regarding what Mendelson-2003 discloses, and we agree with Petitioner. Mendelson-2003 teaches an experimental sensor in which “six PDs [(photodetectors)] were positioned in a close inner-ring configuration . . . [and a] second set of six PDs [were] spaced equally along an outer-ring.” Ex. 1024, 3017, Fig. 1 (depicting a prototype sensor with a near ring of photodetectors and a far ring of photodetectors). Based on experiments using the dual-ring sensor, as compared to sensors using only a near ring or only a far ring, Mendelson-2003 states that “considerabl[y] stronger PPGs [photoplethysmographic signals] could be obtained by widening the active area of the PD which helps to collect a bigger proportion of backscattered light intensity.” *Id.* at 3019, Fig. 3. Mendelson-2003 also states that, “by combining both PD sets to simulate a single large PD area, it is possible to further reduce the driving currents of the LEDs without compromising the amplitude or quality of the detected PPGs.” *Id.* at 3019, Fig. 4. Finally, Mendelson-2003 teaches that estimated battery life for the dual-ring sensor, as compared to sensors using only a near ring or only a far ring, “could be extended considerably.” *Id.* at 3019, Table 1 (battery life of 52.5 days for the dual-ring sensor, compared to 45.8 and 20.3 days for the near ring or far ring sensors, respectively).

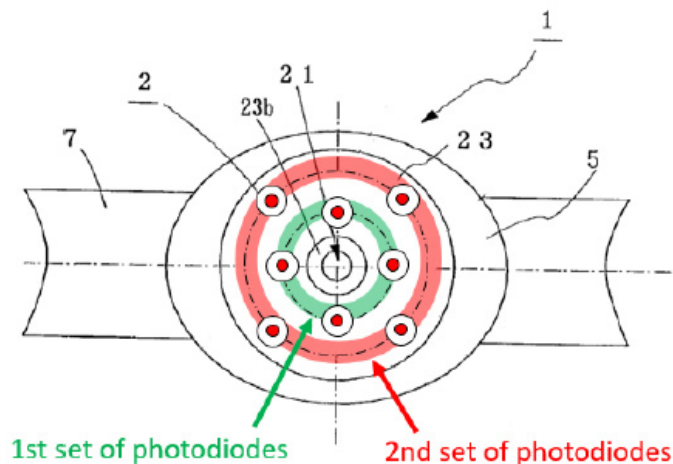
#### Petitioner’s Disputed Contentions

In view of these teachings, Petitioner contends that a person of ordinary skill in the art would have found it obvious to modify Aizawa to

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include an additional ring of detectors, as taught by Mendelson-2003, (i.e., a “second set”) to “advance[e] Aizawa’s goal of improving detection efficiency through increased power savings.” Pet. 20–21 (citing, e.g., Ex. 1003 ¶ 69), 41–43 (citing, e.g., Ex. 1003 ¶¶ 97–100), 48–50 (citing, e.g., Ex. 1003 ¶¶ 107–109). According to Petitioner, “by using Mendelson-2003’s power-saving (and thus efficiency-enhancing) PD configuration, the power consumption of a wrist-based pulse sensing device as in Aizawa can be reduced through use of a less bright and, hence, lower power-consuming LED.” *Id.* at 23 (citing, e.g., Ex. 1003 ¶ 72).

Petitioner provides “[a]n example implementation of adding an additional ring of detectors to Aizawa, as per Mendelson-2003,” which is reproduced below.



Pet. 24 (citing, e.g., Ex. 1003 ¶ 73). Petitioner’s modified and annotated figure depicts Aizawa’s sensor with Aizawa’s first set of photodiodes (depicted as connected by a green ring) and modified to include a second set of photodiodes as taught by Mendelson-2003 (depicted as connected by a red ring). Pet. 23–24, 42–43, 49–50. Petitioner contends this would have been the use of a known solution to improve similar systems in the same



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way, which “would have led to predictable [results] without significantly altering or hindering the functions performed by Aizawa’s sensor,” especially where Aizawa itself discloses adding extra detectors to improve light collection efficiency. *Id.* at 24–25 (citing, e.g., Ex. 1003 ¶ 74).

### Patent Owner’s Arguments

Patent Owner’s arguments address limitations [c]–[e] and [g]–[i] together. *See* PO Resp. 19–21, 54–66. As such, Patent Owner’s arguments, the parties’ Reply and Sur-reply briefing, and our analyses, are presented below in connection with limitations [e] and [h]. *See infra* § II.D.5.iv.

- iv. *“[e] the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream responsive to light from at least one of the one or more light emitters attenuated by body tissue;”*  
*and*  
*“[h] the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream responsive to light from at least one of the one or more light emitters attenuated by body tissue”*

### Petitioner’s Undisputed Contentions

Petitioner contends that a signal stream is sent from Aizawa’s set of photodetectors 22 to drive detection circuit 24, which amplifies the outputs of the photodetectors. Pet. 18–19 (citing, e.g., Ex. 1006 ¶ 23; Ex. 1003 ¶ 67).

Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that “drive detection circuit 24 [is] for detecting a pulse wave by amplifying the outputs of the photodetectors 22.” Ex. 1006 ¶ 23.

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Petitioner additionally contends that Mendelson-2003 teaches that each set of photodiodes, i.e., its near ring and far ring, are wired in parallel, thereby providing a distinct signal stream for each ring. Pet. 21, 44–45 (citing, e.g., Ex. 1024, 3017).

Patent Owner does not dispute this contention regarding what Mendelson-2003 discloses, and we agree with Petitioner. Mendelson-2003 teaches that “[e]ach cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” Ex. 1024, 3017.

#### Petitioner’s Disputed Contentions

In view of these teachings, Petitioner contends that a person of ordinary skill in the art “would have recognized and/or found it obvious that the first set of photodiodes [in the modified system of Aizawa and Mendelson-2003, *see supra* § II.D.5.iii] are connected to one another in parallel to provide a first signal stream in the manner claimed,” and the photodiodes in the second/outer ring (i.e., second set of photodiodes) “are connected to one another in parallel to provide a second signal stream,” as taught by Mendelson-2003. Pet. 44–45, 50 (citing, e.g., Ex. 1003 ¶¶ 103–110), 21–22 (citing, e.g., Ex. 1003 ¶ 71). Petitioner contends this “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor.” *Id.* at 24–25 (citing, e.g., Ex. 1003 ¶ 75).

According to Petitioner, this arrangement would have provided known benefits. Pet. 44–48. For example, Petitioner contends that a person of ordinary skill in the art “would have known that connecting multiple photodiodes together in parallel allows the current generated by the multiple

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photodiodes in [each] set/ring to be added to one another, thereby resulting in a larger total current akin to what would be generated from a single, large detector.” *Id.* at 44. According to Petitioner, this was “a routine and conventional design choice.” *Id.* at 45. Further, “monitoring each signal stream (from each ring of detectors) separately allows the system to determine when the sensor device is so severely located that its position should be adjusted,” and can help detect motion artifacts. *Id.* at 45–46 (citing Ex. 1003 ¶ 104).

Petitioner also argues that a person of skill in the art would have known that “the photodiodes in the far ring (i.e., second set of photodiodes) would receive reflected light having a lower intensity than that received by the photodiodes in the near ring (i.e., first set of photodiodes) and would have been motivated and found it obvious to account for this discrepancy,” e.g., by “keep[ing] each ring separately wired and connected to its own amplifier . . . to thereby keep the magnitude of the current signals provided by each ring approximately the same before being combined and transmitted to the arithmetic circuit 3.” *Id.* at 46–48 (citing Ex. 1003 ¶¶ 105–106); *id.* at 50 (citing Ex. 1003 ¶ 110).

#### Patent Owner’s Arguments

Patent Owner disputes Petitioner’s contentions that it would have been obvious (1) to modify Aizawa to include a second set of at least four photodiodes, and (2) to wire the photodiodes of the first set in parallel to provide a first signal stream and to wire the photodiodes of the second set in parallel to provide a second signal stream. PO Resp. 54–66; Sur-reply 23–29.

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First, Patent Owner argues this proposed modification changes Aizawa's principle of operation. Specifically, Patent Owner claims that "Aizawa's approach monitors different individual detector signals and calculates pulse rate based on each individual photodetector signal" and, in contrast to the proposed modification, "does not measure aggregated signals from detectors connected in parallel." PO Resp. 56 (citing Ex. 1006 ¶¶ 7, 19, 23, 27–29, 32, 36; Ex. 2004 ¶ 102; Ex. 2026, 76:13–22, 79:22–80:3). According to Patent Owner, the proposed modification "eliminates Aizawa's *core feature*—the ability to monitor pulse using the output of each *individual* detector, which Aizawa indicates avoids displacement problems." *Id.* at 57–58 (citing, e.g., Ex. 2004 ¶¶ 104–105).

Second, Patent Owner argues this proposed modification would have resulted in increased power consumption. *Id.* at 58. According to Patent Owner, Mendelson-2003 states that its power savings is caused by "increasing the *number of detectors* and thus the detector area, not the two-ring structure." *Id.* at 58–59 (citing Ex. 1024, 3017; Ex. 2004 ¶ 106). Moreover, Patent Owner argues that Aizawa already discloses a way to improve detection efficiency—by including eight detectors in a single ring. *Id.* at 59 (citing Ex. 1006 ¶ 32, Fig. 4A; Ex. 2004 ¶ 107). In light of this teaching, Patent Owner argues that adding a second ring is unfounded and unnecessary, especially where the second ring of detectors "would receive substantially lower light intensity requiring greater power consumption to utilize than additional detectors added to the 'inner' ring." *Id.* at 59–61 (citing, e.g., Ex. 2004 ¶¶ 108–109; Ex. 2026, 55:7–17, 56:6–16, 59:14–60:7, 100:6–101,6, 102:5–17, 112:3–16). "Petitioner never explains why, given these straightforward options to increase signal strength, a [person of

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ordinary skill in the art] would instead add an entire new circle of detectors farther from the emitter.” *Id.* at 61.

Third, Patent Owner argues that Mendelson-2003 provides only an experimental detector configuration, which would fail to provide the alleged benefits. Specifically, Patent Owner argues that Mendelson-2003 “uses its particular configuration for specific experiments comparing light intensity and LED drive currents for detectors arranged different distances from central emitters,” and “teaches no benefits for this arrangement in practice.” *Id.* at 62–63 (citing Ex. 1024, 3019; Ex. 2004 ¶¶ 111–112). To the contrary, Patent Owner alleges that Mendelson-2003 actually prefers a single detector ring that outputs a single signal stream: “Mendelson 2003 explains it ‘combin[ed] both PD sets to simulate *a single* large PD area,’ and notes ‘battery longevity could be extended considerably by employing *a* wide annular PD,’ which has a single signal stream—not two different signal streams from two different parallel-connected rings.” *Id.* at 62 (citing, e.g., Ex. 2026, 87:8–88:1, 91:15–92:7).<sup>5</sup> Thus, according to Patent Owner, even if a skilled artisan would have added a second ring of detectors to Aizawa,

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<sup>5</sup> Patent Owner also criticizes the Petition’s discussion of another reference, Mendelson ’799 (Ex. 1025), which is not included in Petitioner’s identification of the asserted ground of unpatentability. PO Resp. 62–64; Sur-reply 28–29. We discern no error in Petitioner’s identification of Mendelson ’799. The nature of Petitioner’s reliance on Mendelson ’799 in support of this ground is explained clearly in the Petition, even if Mendelson ’799 is not listed as an additional reference in the identification of the ground. Thus, the Petition complies with 35 U.S.C. § 312(a)(3) (stating an IPR petition must “identif[y], in writing and with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge”).

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they “would not have kept the first and second ring of detectors *separate* or separately amplified the aggregated signals”; instead, they would have “combin[ed] both PD sets to simulate *a single* large PD area,” where “battery longevity could be extended considerably by employing *a* wide annular PD.” *Id.* at 65 (quoting Ex. 1024, 3019; citing Ex. 2004 ¶ 116).

Finally, Patent Owner argues that the proposed combination “introduces signal processing problems requiring a *further* redesign for Aizawa’s sensor” to include a second amplifier to account for signals of different strengths between the near and far rings. *Id.* at 64–65 (citing Ex. 2004 ¶ 115). Patent Owner alleges this demonstrates that a skilled artisan would not have added a second ring of detectors, as proposed, but instead would have increased the number of detectors in Aizawa’s single ring. *Id.* at 65.

#### Petitioner’s Reply

Petitioner replies that Patent Owner mischaracterizes Aizawa’s principle of operation. Pet. Reply 31–33. Specifically, Petitioner contends that Aizawa’s detector ring is connected in parallel, or at least that a person of ordinary skill in the art would have recognized that parallel connection would have been a known implementation detail, which allows a signal to be detected even if one of the multiple sensors is displaced on the user. *Id.* at 32 (citing Ex. 1003 ¶¶ 102–103; Ex. 1060 ¶ 62; Ex. 2026, 72:3–9). Moreover, Petitioner argues that Aizawa lacks any disclosure of individually monitoring signals from each photodetector. *Id.* at 33.

Petitioner reiterates its position that adding a second ring would collect a bigger portion of backscattered light, and would motivate the proposed combination. *Id.* at 33 (citing, e.g., Ex. 1060 ¶¶ 64–66). Petitioner

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also disputes that such a modification would increase power, noting that it is the emitters, not the detectors, that consume most power in the system. *Id.* at 34 (citing, e.g., Ex. 1060 ¶ 67). Moreover, Petitioner contends that by widening the detection area with a second ring, the system would capture additional light which would allow a lower brightness, and lower power, emitter to be used. *Id.* at 24–35.

Petitioner disputes Patent Owner’s characterization of Mendelson-2003 as purely experimental, and alleges that Mendelson-2003 makes clear that employing two rings outputting two signal streams is equivalent to employing a wider single ring of detectors, and provides associated benefits. *Id.* at 35–37 (citing, e.g., Ex. 1060 ¶¶ 70–71).

#### Patent Owner’s Sur-reply

Patent Owner reiterates its position that Aizawa concerns individual monitoring, which Patent Owner alleges is a “key feature of Aizawa’s sensor,” in order to avoid problems associated with sensor displacement. Sur-reply 23–25. Patent Owner also reiterates its positions that the proposed modified sensor would consume more power, and that Aizawa’s disclosed embodiment with eight detectors in a single ring would have been preferred. *Id.* at 25–29.

#### Analysis

We have considered the parties’ arguments and cited evidence, and we are persuaded by Petitioner’s contentions. As discussed above, Aizawa discloses a sensor with a first set of four phototransistors 22 as claimed, which are disposed in a single ring around central emitter 21. Ex. 1006 ¶ 23, Figs. 1(a)–1(b). Mendelson-2003 teaches a sensor with a dual-ring

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configuration, where a first inner ring includes six photodetectors, and a second outer ring includes an additional six photodetectors. Ex. 1024, 3017, Fig. 1. Mendelson-2003 also states that by using this dual-ring configuration to simulate a wide photodetector area, stronger signals could be obtained, drive currents could be reduced, and battery life could be extended. *Id.* at 3019, Figs. 3, 4.

In light of these explicit teachings, we are persuaded by Petitioner’s contention that a person of ordinary skill in the art would have found it obvious to include a second set of detectors in Aizawa’s sensor, as taught by Mendelson-2003, to realize the benefits taught by Mendelson-2003, i.e., stronger signals with reduced power consumption. Pet. 21–23, 44–46. We credit Dr. Kenny’s testimony that this would have been the use of a known solution—a sensor with dual detector rings as taught by Mendelson-2003—to improve similar systems—Aizawa’s sensor with one detector ring—in the same way, which “would have led to predictable results without significantly altering or hindering the functions performed by Aizawa’s sensor,” especially where Aizawa itself discloses adding extra detectors to improve light collection efficiency. Ex. 1003 ¶ 75.

We also credit Dr. Kenny’s testimony that, as taught by Mendelson-2003, it would have been obvious to connect the photodetectors of each set in parallel to provide first and second signal streams, respectively, and that this would have led to predictable results. Ex. 1003 ¶ 74 (predictable), 93–103 (first set), 110 (second set). Indeed, the two rings taught by Mendelson-2003 are disclosed as being “wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.” Ex. 1024, 3017. Dr. Kenny explains numerous advantages



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associated the parallel connections taught by Mendelson-2003, such as monitoring for displacement, accounting for motion artifacts, and compensating for the relative decrease in light that reaches the outer ring, which cannot be achieved with a single signal stream. Ex. 1003 ¶¶ 101–106.

We have considered Patent Owner’s arguments but find them to be misplaced. First, we do not agree that Aizawa discloses the ability to individually monitor individual detectors as a “key feature” (PO Resp. 55; Sur-reply 24) of its sensor. We discern no persuasive support for this position in Aizawa. Aizawa does not discuss individual monitoring at all, at least not clearly, and does not discuss individual monitoring as a solution to sensor displacement. Rather, Aizawa explains that its sensor includes four photodetectors 22 and that “reflected light is detected by the plurality of photodetectors 22.” Ex. 1006 ¶¶ 23, 27. Aizawa also explains that its sensor includes a “drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of the photodetectors 22.” *Id.* ¶ 23. These disclosures indicate that Aizawa does not monitor each photodetector 22 individually to ascertain the pulse wave but, rather, utilizes “the outputs” of *all* of the photodetectors together.

This understanding is consistent with Aizawa’s disclosure of sensor displacement. As Patent Owner correctly notes, Aizawa recognizes a problem with sensor displacement, in which “no output signal can be obtained” if the sensor’s detectors are placed away from an artery. *Id.* ¶ 7. Aizawa solves this problem by avoiding a “linear[]” detector arrangement, such that “[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately.” *Id.* ¶ 9. Indeed, Aizawa is clear that, in its preferred embodiment, it is the disposition of photodetectors 22 in

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“a circle concentric to the light emitting diode 21” that enables accurate pulse detection even when the sensor is dislocated. *Id.* ¶ 27. Aizawa does not discuss individual monitoring in relation to sensor dislocation.

We have examined Patent Owner’s alleged support for the importance of individual monitoring and find it lacking. *See, e.g.*, PO Resp. 56 (citing Ex. 1006 ¶¶ 7, 19, 23, 27–29, 32, 36; Ex. 2004 ¶ 102; Ex. 2026, 76:13–22, 79:22–80:3). Patent Owner identifies Figure 3, which depicts a “diagram of a pulse wave which is the output of a *photodetector*.” Ex. 1006 ¶¶ 19 (emphasis added), 28 (“the above photodetector 22”). Patent Owner seems to place importance on the use of the article “a” or “the” photodetector, in the singular. PO Resp. 56; Sur-reply 24. However, we discern no significance in the singular use. In discussing this Figure, Aizawa does not discuss monitoring an individual photodetector, or describe that as a “key feature”; instead, Aizawa explains that drive detection circuit 24 amplifies the detected pulse wave and transmits it to arithmetic circuit 3, which compares it to a threshold value to calculate a pulse rate. Ex. 1006 ¶ 28. We discern that this discussion of how the circuits process a signal from “a” (or “the”) photodetector is merely exemplary of the process; Patent Owner has not pointed to any persuasive support for its position that this somehow indicates a “key feature” of Aizawa is individual monitoring. As noted above, Aizawa plainly discloses that it is the signals from *the plurality* of photodetectors that is used to determine a pulse wave. *Id.* ¶¶ 23, 27. Nothing in Figure 3 or paragraph 28 clearly contradicts that disclosure.

We have considered the cited testimony of Dr. Madisetti, which Patent Owner relies upon as support for its position, but we find it lacking as well. Dr. Madisetti’s testimony includes the same citations presented by

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Patent Owner, none of which demonstrates individual monitoring. Ex. 2004 ¶ 102. Thus, we determine this testimony to be conclusory and entitled to little weight.

We do recognize, as did Dr. Kenny during his deposition, that Aizawa does not provide extensive discussion of the algorithms through which Aizawa determines a pulse wave. *See, e.g.*, Ex. 2026, 80:8–18 (“It doesn’t describe the algorithm in detail. It just says amplifies the signals from the detectors and then performs whatever function takes place inside the arithmetic circuit. . . . It’s left for one of ordinary skill in the art to process the waveforms.”). Nonetheless, we decline Patent Owner’s invitation to import into Aizawa’s disclosure a “key feature” of individual monitoring that is not identified by Aizawa with any reasonable clarity. Again, as noted above, Dr. Madisetti provides no further support for the conclusory position advanced by Patent Owner.

By contrast, we credit Dr. Kenny’s testimony, which is consistent with Aizawa’s express disclosure of detecting a pulse wave from “the plurality of photodetectors” (Ex. 1006 ¶ 27), that:

connecting multiple photodetectors together in parallel allows the current generated by the multiple photodetectors to be added to one another, which would subsequently ensure that even if one of multiple sensors connected in parallel were to be displaced so as to receive no signal, the fact that all the sensors are connected in parallel such that their signals are summed means that a signal will still be detected, in accordance with Aizawa’s objective.

Ex. 1060 ¶ 62. Moreover, we agree with Dr. Kenny that “there is no disclosure anywhere in Aizawa to suggest that it is even capable of somehow monitoring the signals of each photodetector, and there is certainly no need to do so if its sensors are connected in parallel.” *Id.* Thus,

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considering the express disclosure of Aizawa and the competing testimony of the parties' experts, we credit that of Dr. Kenny.

Patent Owner's second argument—that the proposed modification would have resulted in increased power consumption—is plainly contradicted by Mendelson-2003's disclosure. Table 1 of Mendelson-2003 is reproduced below.

**Table 1.** Comparison of estimated battery life for different PD configurations. Values based on forehead measurements for a typical 220mAh coin size battery.

PD CONFIGURATION	BATTERY LIFE [Days]
Near	45.8
Far	20.3
Near+Far	52.5

Table 1 includes three rows, each associating a different photodetector configuration with an estimated battery life. Ex. 1024, 3019. The table indicates that a configuration consisting of only a near ring of photodetectors results in 45.8 days of battery life; a configuration consisting of only a far ring of photodetectors results in 20.3 days of battery life; and a configuration consisting of both a near ring and a far ring of photodetectors results in 52.5 days of battery life. *Id.* In describing this table, Mendelson-2003 states, “the considerable differences in the estimated power consumptions clearly points out the practical advantage gained by using a reflection sensor comprising a large ring-shaped PD area to perform SpO<sub>2</sub> measurements,” which in this case, was realized by the combination of a near and far ring of detectors, akin to the modification proposed by Petitioner. *Id.* Thus, we do not agree with Patent Owner's argument that power consumption would increase if a second ring of detectors were added to Aizawa's sensor; Mendelson-2003 plainly suggests the opposite and supports Petitioner's

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contention that the proposed modification would result in a power savings over a single ring.

We also do not agree with the argument that a person of ordinary skill in the art would not make the proposed modification because Aizawa already discloses a way to improve detection efficiency, e.g., by including more detectors in a single ring. PO Resp. 59 (citing Ex. 1006 ¶ 32, Fig. 4A; Ex. 2004 ¶ 107). Aizawa explains that the photodetector arrangement of its single-ring preferred embodiment “is not limited” and suggests, “[f]or example,” that “the number of photodetectors 22 may be increased.” Ex. 1006 ¶ 32. Aizawa does not limit the increase in photodetectors to being included in only the existing single ring of detectors, i.e., the first set. Nothing in this disclosure teaches against adding a second set, as proposed by Petitioner for the well-supported reasons identified in Mendelson-2003 and further discussed by Dr. Kenny.

Patent Owner’s third argument—that Mendelson-2003 is experimental and would not provide the alleged benefits—likewise fails. Patent Owner’s suggestion that Mendelson-2003 teaches using a single large, wide detector ring that outputs a single signal stream is unfounded. The analysis provided in Mendelson-2003 explicitly compares a dual-ring arrangement to both a single near ring and a single far ring. *See, e.g.*, Ex. 1024, Figs. 3, 4, Table 1 (all comparing near, far, and near + far arrangements). Mendelson-2003 explains that the dual-ring arrangement “simulate[s] a single large PD area” and realizes benefits in LED power requirements. *Id.* at 3019. That Mendelson-2003 *simulates* a single ring by using two discrete rings demonstrates the fallacy of Patent Owner’s argument.

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Finally, we disagree with Patent Owner’s argument that a person of ordinary skill in the art would not have made the proposed combination because it “introduces signal processing problems requiring a *further* redesign for Aizawa’s sensor” to include a second amplifier to account for signals of different strengths between the near and far rings. PO Resp. 64–65. A person of ordinary skill in the art must be presumed to understand something about the art beyond what is disclosed in the references. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962). After all, “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR*, 550 U.S. at 421. Neither Patent Owner nor Dr. Madisetti assert that adding a second amplifier would be beyond the level of skill in the art or would introduce any specific problems, beyond its mere addition. We credit Dr. Kenny’s testimony that a person of ordinary skill would have recognized that, in order to account for the disparate currents generated by the two rings, the rings would be separately wired with separate amplifiers (Ex. 1003 ¶ 106) and that this would have been a routine and conventional design choice, within the level of ordinary skill in the art (*id.* ¶ 103).

For the foregoing reasons, we are persuaded by Petitioner’s contentions.

- v. “[i] at least one of the first signal stream or the second signal stream includes information usable to determine a physiological parameter of a wearer of the noninvasive physiological parameter measurement device;”

The cited evidence supports Petitioner’s undisputed contention that Aizawa discloses a signal stream usable to determine at least pulse rate. Pet. 43–48, 51. Petitioner contends that “Aizawa teaches that a ‘drive detection circuit 24’ is used for ‘amplifying the outputs [*i.e.*, signal stream]

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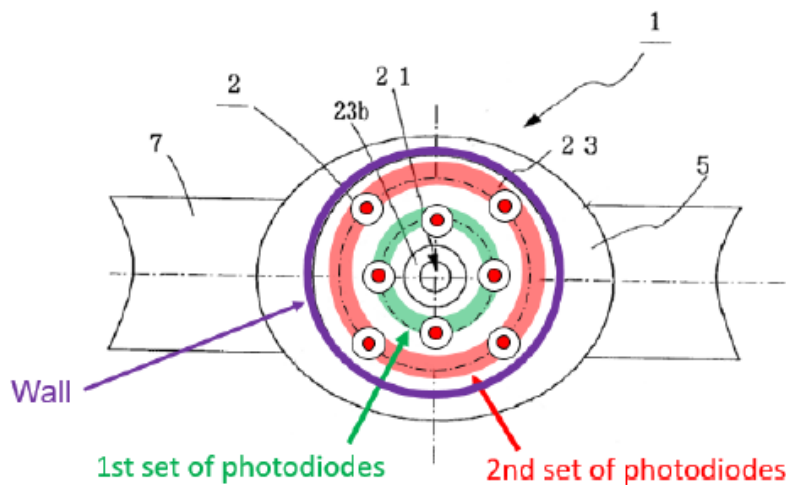
of the photodetectors’ and transmitting the amplified data to the arithmetic circuit 3, which computes the pulse rate, which is a physiological parameter.” Pet. 51 (quoting Ex. 1006 ¶¶ 23, 28) (citing Ex. 1003 ¶ 111 (“Because the signal stream from Aizawa’s detectors can be used to calculate pulse rate, it represents information usable to determine a physiological parameter of a wearer of the noninvasive physiological parameter measurement device.”)).

- vi. *“[j] a wall extending from the surface and configured to surround at least the first and second sets of photodiodes; and”*

The cited evidence also supports Petitioner’s undisputed contention that Aizawa discloses a wall that surrounds the photodiodes, including the second set as suggested by the combined teachings of Aizawa and Mendelson-2003. Pet. 51–52; *see, e.g.*, Ex. 1006 ¶ 23 (“holder 23 for storing” LED 21 and detectors 22), Fig. 1(b) (depicting periphery of holder 23 surrounding the sensor components, including detectors 22, which are positioned on a surface); Ex. 1003 ¶¶ 100–102, 112. Petitioner contends that “[t]he outer periphery of Aizawa’s holder 23 provides a circular wall (purple) that surrounds at least the first and second sets of photodiodes,” and provides an annotated version of Aizawa’s Figure 1(a), which is reproduced below.

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Petitioner’s modified and annotated Figure 1(a) of Aizawa depicts a wall (purple) surrounding both the first set of photodiodes and the second set of photodiodes. Pet. 52. Petitioner likewise contends that the identified wall extends from the surface of the substrate. *Id.* These undisputed contentions are sufficiently supported.

- vii. “[k] a cover arranged to cover at least a portion of the surface of the substrate, wherein the cover comprises a protrusion that extends over all of the photodiodes of the first and second sets of photodiodes arranged on the surface, and wherein the cover is further configured to cover the wall.”

#### Petitioner’s Undisputed Contentions

Petitioner contends that Aizawa “teaches a light permeable cover in the form of an acrylic transparent plate 6 . . . that is mounted at the detection face 23a” of the sensor, i.e., above Aizawa’s photodetectors, to provide “improved adhesion between the detector and the wrist to ‘further improv[e] the detection efficiency of a pulse wave.’” Pet. 10–11 (citing Ex. 1006 ¶ 30, Fig. 1(b); Ex. 1003 ¶¶ 52–53). Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that “acrylic



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transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to the wrist 10.” Ex. 1006 ¶ 34, Fig. 1(b) (depicting transparent plate 6 between sensor 2 and wrist 10).

Petitioner also contends that Ohsaki teaches a wrist-worn sensor that includes a “translucent board” having a convex surface that contacts the user’s skin to prevent slippage of the sensor. Pet. 14, 26–27 (citing Ex. 1014 ¶¶ 9–10). Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 includes detecting element 2 and sensor body 3, and is “worn on the back side of the user’s wrist 4.” Ex. 1014 ¶ 16. Ohsaki discloses that detecting element 2 includes package 5 and “translucent board 8[,which] is a glass board which is transparent to light, and [is] attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8.” *Id.* ¶ 17. As seen in Ohsaki’s Figure 2, translucent board 8 has a single protruding convex surface, which is placed between a user’s tissue and a light receiving element (e.g., photodetector) 7 when the sensor is worn. *Id.* at Fig. 2. As also seen in Figure 2, the board 8 is operably connected to the walls of sensor package 5. *Id.* ¶ 17 (“The translucent board 8 is . . . attached to the opening of the package 5.”), Fig. 2.

#### Petitioner’s Disputed Contentions

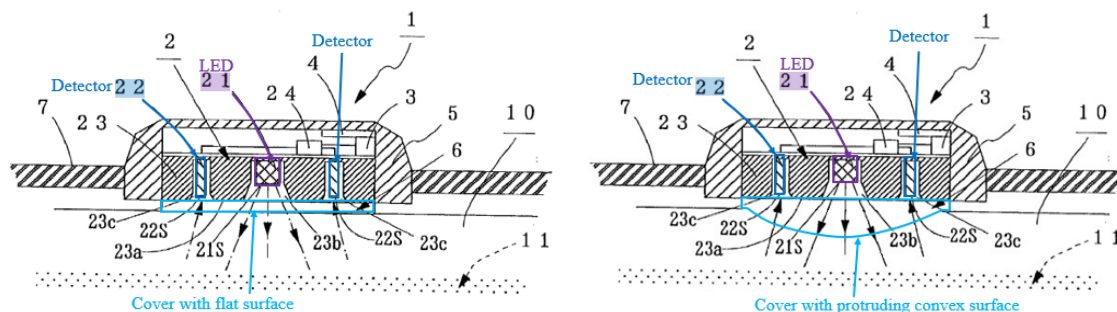
Petitioner further contends that a person of ordinary skill in the art “would have found it obvious to modify Aizawa’s sensor to include a cover having a protruding convex surface,” so as to (1) improve adhesion between the user’s wrist and the sensor’s surface, (2) improve detection efficiency, and (3) protect the elements within sensor housing. Pet. 25–29 (citing, e.g., Ex. 1003 ¶¶ 76–80; Ex. 1014 ¶ 25). Petitioner contends that Ohsaki’s

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convex surface is in “intimate contact” with the user’s skin, which prevents slippage of the sensor and increases signal strength because “variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed” and because “the pulse wave can be detected without being affected by the movement of the user’s wrist 4,” as compared to a sensor with a flat surface. *Id.* at 26–28 (citing, e.g., Ex. 1003 ¶ 78; quoting Ex. 1014 ¶¶ 15, 17, 25, Figs. 1, 2, 4A, 4B). Accordingly, Petitioner contends that a person of ordinary skill in the art would have modified Aizawa’s sensor to include a cover with a protruding convex surface, as taught by Ohsaki, that is “between a subject’s wrist and a surface of the sensor.” Pet. 25–29 (citing, e.g., Ex. 1003 ¶¶ 76–80).

Petitioner contends this modification would have been “nothing more than the use of a known technique to improve similar devices in the same way,” i.e., when Ohsaki’s sensor is worn ““the convex surface of the translucent board . . . is in intimate contact with the . . . user’s skin”; this contact . . . prevents slippage, which increases the strength of the signals obtainable by Ohsaki’s sensor.” Pet. 26–29 (citing Ex. 1003 ¶¶ 77–80).

To illustrate its proposed modification, Petitioner includes two annotated versions of Aizawa’s Figure 1(b), both of which are reproduced below. Pet. 25–29 (citing Ex. 1003 ¶¶ 76–80).



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Petitioner's annotated figure on the left depicts Aizawa's sensor, modified to include a flat "acrylic transparent plate" (illustrated with blue outline); Petitioner's annotated figure on the right depicts Aizawa's sensor, modified to include a "cover with protruding convex surface" (illustrated with blue outline). Pet. 29.

### Patent Owner's Arguments

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Aizawa's sensor to include Ohsaki's convex cover. PO Resp. 11–18, 22–54;<sup>6</sup> Sur-reply 3–23.

First, Patent Owner argues "Ohsaki's rectangular board would be incompatible with Aizawa's circular sensor arrangement" and that the proposed modification "eliminates the longitudinal shape that Ohsaki specifically identifies as important for the benefit of reducing slipping." PO Resp. 23–25 (emphases omitted). This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to

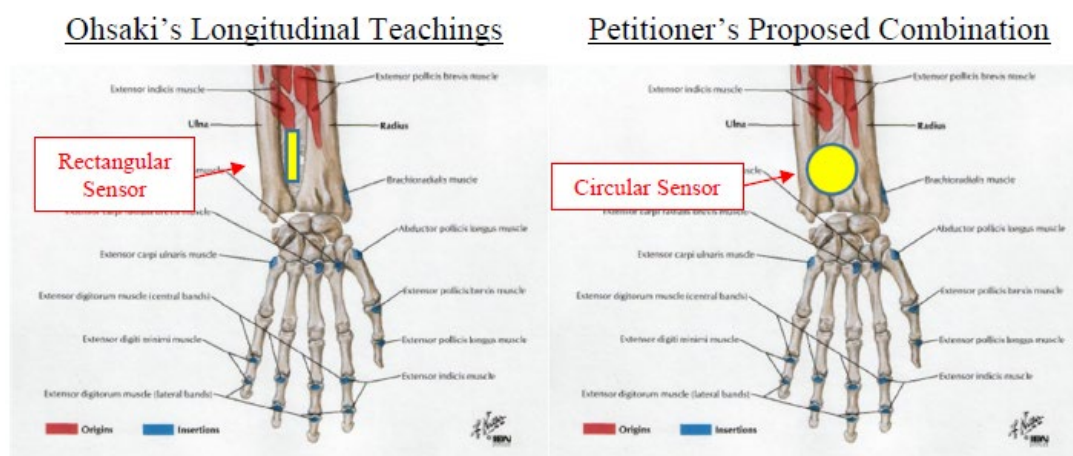
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<sup>6</sup> As an initial matter, Patent Owner observes that Petitioner "[r]eli[es] on a non-ground reference, Inokawa" (Ex. 1008), as providing the rationale for the proposed modification of Aizawa in view of Ohsaki, and as providing implementation details of the combination. PO Resp. 22–23 (citing Pet. 30–31); *id.* at 45–46, 51–52. We discern no error in Petitioner's identification of Inokawa. The nature of Petitioner's reliance on Inokawa in support of this ground is explained clearly in the Petition, even if Inokawa is not listed as an additional reference in the identification of the ground. Thus, the Petition complies with 35 U.S.C. § 312(a)(3) (stating an IPR petition must "identif[y], in writing and with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge").

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avoid interacting with bones in the wrist and forearm. *Id.* at 25–30 (citing, e.g., Ex. 2004 ¶¶ 55–62; Ex. 1014 ¶¶ 6, 19, 23–25); *see also* Sur-reply 3–11. According to Patent Owner, Ohsaki teaches that “aligning the sensor’s longitudinal direction with the circumferential direction of the user’s arm undesirably results in ‘a tendency [for Ohsaki’s sensor] to slip off.’” PO Resp. 26 (emphasis omitted) (alteration in original) (citing Ex. 1014 ¶ 19).

Thus, Patent Owner contends that Petitioner’s proposed modification would “chang[e] Ohsaki’s longitudinal detecting element and rectangular board into a circular shape,” which “would eliminate the advantages discussed above” because it “cannot be placed in any longitudinal direction and thus cannot coincide with the longitudinal direction of the user’s wrist.” *Id.* at 27 (emphases omitted) (citing Ex. 2004 ¶¶ 57–58). Patent Owner presents annotated Figures depicting what it contends is Ohsaki’s disclosed sensor placement as compared to that of the proposed modification, reproduced below.



Patent Owner’s annotated Figure on the left depicts a rectangular sensor placed between a user’s radius and ulna, while Patent Owner’s annotated Figure on the right depicts a circular sensor placed across a user’s radius and

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ulna. Based on these annotations, Patent Owner argues that the proposed “circular shape would press on the user’s arm in all directions and thus cannot avoid undesirable interaction with the user’s bone structure,” such that a skilled artisan “would have understood that any such change would eliminate any benefit of Ohsaki’s board for preventing slipping.” PO Resp. 28–30 (citing, e.g., Ex. 2004 ¶¶ 55–62).<sup>7</sup>

Patent Owner additionally argues that changing Aizawa’s circular sensor to accommodate Ohsaki’s longitudinal structure “would redirect light away from some detectors and towards others” and would “disrupt Aizawa’s sensor’s circular symmetry.” *Id.* at 30–32. This argument is premised on Patent Owner’s contention that Ohsaki’s convex cover must be rectangular. *Id.* at 30 (citing Ex. 2004 ¶¶ 63–64). According to Patent Owner, “placing Ohsaki’s rectangular board onto Aizawa’s circular sensor would result in undesirable asymmetrical pressure and inconsistent contact at the peripheral edge where Aizawa’s detectors are located,” which would “create air gaps over some of Aizawa’s peripherally arrayed detectors, but not others, which could result in degraded optical signals.” *Id.* at 31–32 (emphasis omitted) (citing Ex. 2004 ¶¶ 65–66). Thus, Patent Owner argues that a person of ordinary skill in the art “would not have been motivated to use Ohsaki’s rectangular board with Aizawa’s circular sensor.” *Id.* at 32 (citing Ex. 2004 ¶¶ 65–66).

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<sup>7</sup> Patent Owner further argues, “[t]o the extent Petitioner contends a [person of ordinary skill in the art] would use Ohsaki’s rectangular board on Aizawa’s circular sensor . . . that argument is unsupported and incorrect.” PO Resp. 30. We do not read the Petition as making such a contention. We understand Petitioner to propose, in essence, changing Aizawa’s circular *flat* cover into a circular *convex* cover. *See, e.g.,* Pet. 28–29.

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Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Aizawa's sensor. PO Resp. 33. Specifically, Patent Owner argues that Aizawa's sensor must be worn on the palm side of the wrist, close to radial and ulnar arteries, which is the side opposite from where Ohsaki's sensor is worn. *Id.* at 33–42 (citing, e.g., Ex. 1006 ¶¶ 2, 7, 9, 26, 27, 36; Ex. 2004 ¶¶ 68–81). According to Patent Owner, Ohsaki teaches that the sensor's convex surface has a tendency to slip when placed on the palm side of the wrist, i.e., in the location taught by Aizawa. *Id.* at 39–42 (citing, e.g., Ex. 1014 ¶¶ 19, 23–24; Ex. 2004 ¶¶ 75–81). Thus, Patent Owner argues that a person of ordinary skill in the art “would not have been motivated to use Ohsaki's longitudinal board—designed to be worn on the back side of a user's wrist—with Aizawa's palm-side sensor.” *Id.* at 42 (emphases omitted). Similarly, Patent Owner argues that Aizawa teaches away from the proposed modification because Aizawa teaches that its flat acrylic plate improves adhesion on the palm side of the wrist, while Ohsaki teaches that its convex board “has a tendency to slip” on the palm side of the wrist. *Id.* at 33–39 (citing, e.g., Ex. 2004 ¶¶ 67–74).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Aizawa's peripheral detectors because the convex cover would condense light toward the center and away from Aizawa's detectors, which would decrease optical signal strength. PO Resp. 45–53 (citing, e.g., Ex. 2004 ¶¶ 86–97). Patent Owner also contends that Petitioner and Dr. Kenny admitted as much in a related proceeding. *Id.* at 46–47 (citing, e.g., Ex. 2019, 45; Ex. 2020, 69–70). Patent Owner also relies on Figure 14B of the '366 patent to support its

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position. *Id.* at 47–48 (citing Ex. 1001, 36:3–6, 36:13–15). In light of the foregoing, Patent Owner argues that a person of ordinary skill in the art would have understood that the proposed modification would have decreased signal strength by directing light away from Aizawa’s peripheral detectors. *Id.* at 47.

Fourth and finally, Patent Owner argues that a person of ordinary skill in the art “would have understood that Aizawa’s flat plate would provide better protection than a convex surface” because it “would be less prone to scratches.” *Id.* at 53–54 (emphasis omitted) (citing Ex. 1008 ¶ 106; Ex. 2004 ¶¶ 98–99).

#### Petitioner’s Reply

Concerning Patent Owner’s first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve the disclosed benefits. Pet. Reply 8–20 (citing, e.g., Ex. 1060 ¶¶ 7–30). Moreover, Petitioner asserts that “[e]ven if Ohsaki’s translucent board 8 were understood to be rectangular, obviousness does not require ‘bodily incorporation’ of features from one reference into another”; rather, a person of ordinary skill in the art “would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the benefits” taught by Ohsaki. *Id.* at 16 (citing, e.g., Ex. 1060 ¶ 23). Similarly, regarding the location of the sensor, Petitioner asserts,

[E]ven assuming for the sake of argument that a [person of ordinary skill in the art] would have understood Aizawa’s sensor as being limited to placement on the backside of the wrist, and would have understood Ohsaki’s sensor’s “tendency to slip”

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when arranged on the front side as informing consideration of Ohsaki's teachings with respect to Aizawa, that **would have further motivated** the [person of ordinary skill in the art] to implement a light permeable convex cover in Aizawa's sensor, to improve detection efficiency of that sensor when placed on the palm side.

*Id.* at 18 (citing, e.g., Ex. 1060 ¶ 27). In other words, Ohsaki's disclosure that a convex surface suppresses variation in reflected light would have motivated an artisan to add such a surface to Aizawa to improve detection efficiency of that sensor when placed on the palm side. *Id.* at 18.

Concerning Patent Owner's third argument, Petitioner responds that adding a convex cover to Aizawa's sensor would not decrease signal strength but, instead, "would improve Aizawa's signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa's photodetectors than would have with a flat cover" because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 20–21 (citing, e.g., Ex. 1060 ¶ 31).

Petitioner asserts that Patent Owner and Dr. Madiseti "ignore[] the well-known principle of reversibility," by which "a ray going from P to S will trace the same route as one from S to P." Pet. Reply 22 (emphasis omitted) (quoting Ex. 1061, 84, 92; Ex. 1062, 101, 110; Ex. 1053, 80:20–82:20). When applied to Aizawa's sensor, Petitioner contends that any condensing benefit achieved by a convex cover would thus direct emitted light toward Aizawa's peripheral detectors. *Id.* at 22–25 (citing, e.g., Ex. 1060 ¶¶ 35–45). Indeed, Petitioner contends this core concept of reversibility is applied in Aizawa. *Id.* at 25 (citing, e.g., Ex. 1006 ¶ 33; Ex. 1060 ¶¶ 41–44).



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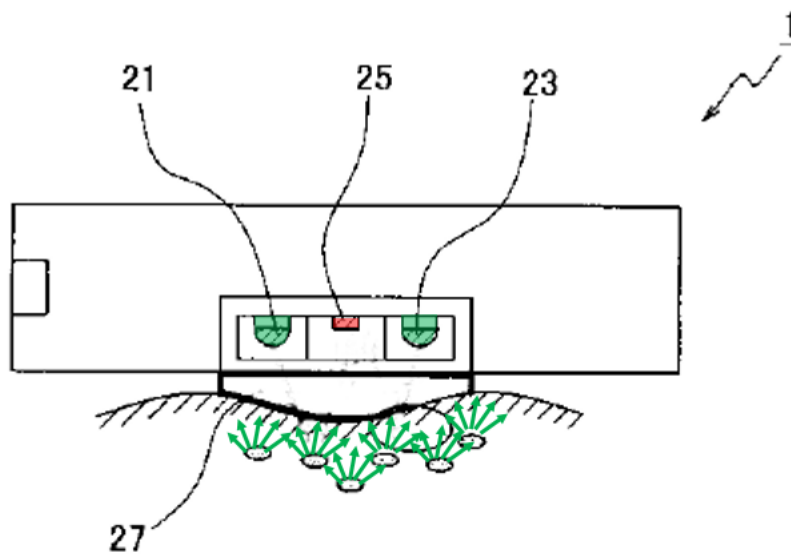
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Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue will be scattered and diffuse and will approach the detectors “from various random directions and angles.” Pet. Reply 25–30 (citing, e.g., Ex. 1060 ¶¶ 46–59; Ex. 1061, 84 Ex. 1062, 101; Ex. 1063, 52, 86, 90; Ex. 1053, 80:20–82:20). This scattered and diffuse light, according to Petitioner, means that Ohsaki’s convex cover cannot “focus[] light to the center” of the sensor device, as Patent Owner argues. *Id.* at 26. Instead, due to the random nature of this scattered light, Petitioner asserts that a person of ordinary skill in the art would have understood that “Ohsaki’s convex cover provides a slight refracting effect, such that light rays that may have missed the detection area are instead directed toward that area.” *Id.* at 26 (citing, e.g., Ex. 1060 ¶¶ 48–49). Petitioner applies this understanding to Aizawa, and asserts that using a cover with a convex protrusion in Aizawa would “enable backscattered light to be detected within a circular active detection area.” *Id.* (citing, e.g., Ex. 1063, 86, 90).

Petitioner relies upon the following illustration of this alleged effect. Pet. Reply 29 (citing Ex. 1060 ¶ 54).

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The above illustration depicts backscattered light with Aizawa's sensor reflecting off user tissue in various directions, such that it impinges upon the peripheral detectors from various random angles and directions. *Id.*

According to Petitioner, this allows the detector to capture "light rays that otherwise would have missed the active detection area are instead directed toward that area." *Id.* (citing Ex. 1060 ¶ 55).

Petitioner also dismisses Patent Owner's reliance on Figure 14B of the '366 patent because it "is not a representation of light that has been reflected from a tissue measurement site." Pet. Reply 28 (citing, e.g., Ex. 1060 ¶¶ 51–52). According to Petitioner, for example, "[t]he light rays (1420) shown in FIG. 14B are collimated (i.e., parallel to one another), and each light ray's path is perpendicular to the detecting surface." *Id.*

Concerning Patent Owner's fourth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the "known advantages of applying Ohsaki's teachings," and would not negate a motivation to combine. *Id.* at 31 (citing, e.g., Ex. 1060 ¶ 60).

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Patent Owner's Sur-reply

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that "even small changes in sensor orientation or measurement location result in slippage." Sur-reply 1–14, 8.

Concerning Patent Owner's third argument (that the convex cover would condense light toward the center and away from Aizawa's detectors), Patent Owner asserts that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 14–16, 19–21. Patent Owner argues that Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *Id.* at 16 (regarding reversibility), 16–19. Moreover, Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes conditions that are not present when tissue scatters and absorbs light." *Id.* at 16. The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether changing Aizawa's flat surface to a convex surface results in more light on Aizawa's peripherally located detectors." *Id.* at 17–18.

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that Ohsaki's cover with a convex protrusion "focuses *all* light to a single point" at the center of the sensor as Petitioner characterizes it. Sur-reply 19. Patent Owner's position, rather, is that Petitioner has not shown that a person of ordinary skill in the art "would

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have been motivated to change Aizawa's flat surface to a convex surface to improve signal strength." *Id.* In Patent Owner's view, by arguing that the convex cover provides only a "slight refracting effect," Petitioner undermines its contention that providing such a cover would have improved detection efficiency. *Id.* at 19–20 (emphasis omitted).

Patent Owner also argues that Petitioner's contention that a convex cover allows more light collection generally is a new theory not supported by Dr. Kenny's original declaration. *Id.* at 20. Moreover, Patent Owner argues that Petitioner's theory is "unavailing because it fails to consider the greater decrease in light at the detectors due to light redirection to a more central location." *Id.* (emphasis omitted). According to Patent Owner, any light redirected from the sensor's edge could not make up for the loss of signal strength from light redirected away from the detectors and toward the center. *Id.*

Concerning Patent Owner's fourth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover would be less prone to scratches and offers "**no** plausible advantages for its asserted combination." *Id.* at 23. Moreover, Patent Owner argues that the risk of scratches undermines Petitioner's argument of adding a convex cover to protect the elements within the sensor housing. *Id.*

### Analysis

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided "a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, to Aizawa's sensor: (1) to improve adhesion between the sensor and the user's tissue, (2) to improve detection efficiency, and (3) to protect

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the elements within the sensor housing. Pet. 26–32 (citing, e.g., Ex. 1003 ¶¶ 76–84; Ex. 1014 ¶ 25). As further examined below, we determine all three rationales are supported by the evidence, and further that any single rationale standing alone would have been sufficient to establish a basis for the person of ordinary skill in the art to combine the references as proposed.

### Rationales 1 and 2

The evidence of record persuades us that adding a convex cover, such as that taught by Ohsaki, would have improved adhesion between the sensor and the user’s skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user’s skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user’s wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user’s wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user’s skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.* Therefore the pulse wave can be detected without being affected by the movement of the user’s wrist 4 as shown in FIG. 4A.

Ex. 1014 ¶ 25 (emphasis added); *see also id.* ¶ 27 (“detecting element 2 is stably fixed”).

We credit Dr. Kenny’s testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Aizawa to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the

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user's wrist and to suppress variation. *See, e.g.*, Ex. 1003 ¶¶ 77 (“[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor.”), 79 (One of ordinary skill would have understood that this would “improve adhesion between the user's wrist and the sensor's surface, improve detection efficiency.”). We find persuasive Dr. Kenny's explanation that the person of ordinary skill in the art “would have understood that a protruding convex cover would reduce the adverse effects of user movement on signals obtainable by photodetectors which are positioned to detect light reflected from user tissue.” Ex. 1060 ¶ 13.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1014, Figs. 4A–4B, ¶¶ 15, 25 (stating that with “a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4,” and with “a convex surface like the present embodiment, the variation of the amount of the reflected light” collected by the sensor “is suppressed”). Ohsaki also states that, with a convex surface, “[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.” *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the skill level of an ordinary artisan. For example, Dr. Kenny testifies that one of ordinary skill would have combined the teachings of Aizawa and Ohsaki as “doing so would have amounted to nothing more than the use of a known technique to improve similar devices

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in the same way” and the combined elements “would each perform similar functions they had been known to perform prior to the combination.”

Ex. 1003 ¶ 80. In particular, one of ordinary skill would have recognized that by incorporating Ohsaki’s convex surface, “the convex surface of the translucent board . . . is in intimate contact with the surface of the user’s skin”; this contact between the convex surface and the user’s skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki’s sensor.” *Id.* ¶ 77 (citing Ex. 1014 ¶¶ 15, 17, 25, Figs. 1, 2, 4A, 4B).

In light of Ohsaki’s express disclosure of the benefits of a convex cover, we credit Dr. Kenny’s testimony that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner’s first through third arguments, each of which implicates Petitioner’s first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner’s first argument is premised on the notion that Ohsaki’s benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user’s forearm. PO Resp. 11–30. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1014 ¶ 17. Ohsaki’s convex surface is located on board 8, which is “attached to the opening of the

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package 5.” *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex protrusion.

We disagree with Patent Owner’s suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki’s Figures 1 and 2. PO Resp. 11–12. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1014 ¶ 13 (“schematic diagram”); *see also* Pet. Reply 8–16; *Hockerson-Halberstadt, Inc. v. Avia Group Int’l, Inc.*, 222 F.3d 951, 956 (Fed. Cir. 2000) (“[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.”).

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: “[T]he length of the detecting element 2 from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side.” Ex. 1014 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user’s forearm: “[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user’s arm,” to avoid slipping off. *Id.*; *see also id.* ¶ 9 (“The light emitting element and the light receiving element are arranged in the longitudinal direction of the user’s arm.”).

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki’s convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner’s argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply 13–14 (noting also that



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“Ohsaki never describes the ‘translucent board 8’ as ‘longitudinal,’ and nowhere describes ‘translucent board 8’ and ‘detecting element 2’ as having the same shape.”). We have considered the testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1060 ¶¶ 8–16; Ex. 2004 ¶¶ 36–39 (relying on Ohsaki’s Figures 1–2 to support his opinion that the convex surface is rectangular). Dr. Madisetti’s reliance on the dimensions of Ohsaki’s figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny’s testimony that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki’s disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user’s forearm. PO Resp. 24–30; Sur-reply 4–8, 10 (“[A] POSITA would have understood Ohsaki’s convex board must *also* have a longitudinal shape oriented up-and-down the watch-side of the user’s wrist/forearm.”). Although Ohsaki recognizes that interaction with these bones can cause problems, *see* Ex. 1014 ¶¶ 6, 19, we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user’s forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 28, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical

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obstacles. “A person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See Jacoby*, 309 F.2d at 516.

Finally, we do not agree with Patent Owner’s position that Ohsaki’s advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki’s convex surface is rectangular at all. Moreover, even if Ohsaki’s convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that “detecting element 2 is arranged on the user’s wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user’s skin,” which prevents the detecting element from slipping off the detecting position of the user’s wrist. Ex. 1014 ¶ 25; Ex. 1060 ¶ 21. Thus, we agree with Petitioner that Ohsaki’s teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa’s circular-shaped sensor, to improve adhesion as taught by Ohsaki. *See, e.g.*, Pet. 20–23. Nothing in Ohsaki’s disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1060 ¶¶ 10–11, 14–23.

Moreover, Ohsaki contrasts the ability to properly receive reflected light with a convex surface as compared to a flat surface and notes that,

in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user’s skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.

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Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1014 ¶ 25; Ex. 1060 ¶¶ 12–13. Again, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's sensor, to improve signal strength, as taught by Ohsaki. *See, e.g.*, Pet. 26–29. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1060 ¶¶ 10–11, 18–23.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Aizawa and Ohsaki.

We have also considered Patent Owner's arguments that Petitioner's proposed modification would disrupt Aizawa's "circular symmetry." *See* PO Resp. 30–32. We do not agree for the reasons set forth above. Further, Petitioner's proposed modification is not a bodily incorporation. That is, Petitioner does not propose a bodily incorporation of Ohsaki's rectangular board into Aizawa's circular cover, but only modifying Aizawa only to include a cover with a convex surface. Pet. Reply 15–16; Pet. 25. Further, we discern that it would have been within the capability of an ordinarily skilled artisan to eliminate any gap that would have decreased signal strength or quality. Ex. 1060 ¶ 23.

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is the opposite side of the wrist taught by Aizawa. PO Resp. 33–42. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply

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proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. *See, e.g.,* Pet. 25. In other words, Petitioner's proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki's Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when the element is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1014 ¶¶ 23–24, Figs. 3A–3B. However, we do not agree that these figures support Dr. Madisetti's conclusion that “Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different locations or orientations” such as the palm side of the wrist—particularly in comparison to a flat surface such as Aizawa's. Ex. 2004 ¶¶ 35, 67. Instead, Ohsaki acknowledges that, even when the detecting element is located “on the front [palm] side of the user's wrist 4, *the pulse wave can be detected well* if the user is at rest.” Ex. 1014 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user's wrist achieves benefits. *Id.* Notably, Ohsaki's claims are not limited to detection during movement or exercise.

We credit, instead, Dr. Kenny's testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's sensor. *See* Ex. 1060 ¶¶ 10–11, 24–30. This is because the convex protrusion “promot[es] ‘intimate contact with the surface of the user's skin,’” which “would have increased adhesion and reduced slippage of Aizawa's sensor

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when placed on either side of a user's wrist or forearm, and additionally would have provided associated improvements in signal quality.” *Id.* ¶¶ 29–30 (“additional adhesive effect”).

Dr. Madisetti testifies that

[b]ased on Aizawa's teaching that a flat acrylic plate improves adhesion on the palm side of the wrist, and Ohsaki's teaching that a convex surface tends to slip on the palm side of the wrist, a [person of ordinary skill in the art] would have come to the opposite conclusion from Dr. Kenny: that modifying Aizawa's “flat cover . . . to include a lens/protrusion . . . similar to Ohsaki's translucent board” would not “improve adhesion.”

Ex. 2004 ¶ 85; *see also id.* ¶ 67. We disagree with this reading of Aizawa. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate “improve[s] adhesion” (*id.* ¶ 13). Aizawa further states: “the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10,” and “[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.” *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *See also id.* ¶¶ 30, 34 (“Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved.”). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with. Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa's detector to the user's wrist.

We have considered Patent Owner's third argument that a convex cover would condense light away from Aizawa's peripheral detectors, which

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Patent Owner alleges would decrease signal strength. PO Resp. 45–53. We disagree.

There appears to be no dispute that when emitted light passes through user tissue, the light diffuses and scatters as it travels. *See, e.g., Pet. Reply 25* (“[R]eflectance-type sensors work by detecting light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector,’ thus, a person of ordinary skill in the art “would have understood that light that backscatters from the measurement site after diffusing through tissue reaches the active detection area from random directions and angles.”) (quoting Ex. 1063, 86); *Sur-reply 16* (“Even Petitioner admits that tissue randomly scatters and absorbs light rays.”).

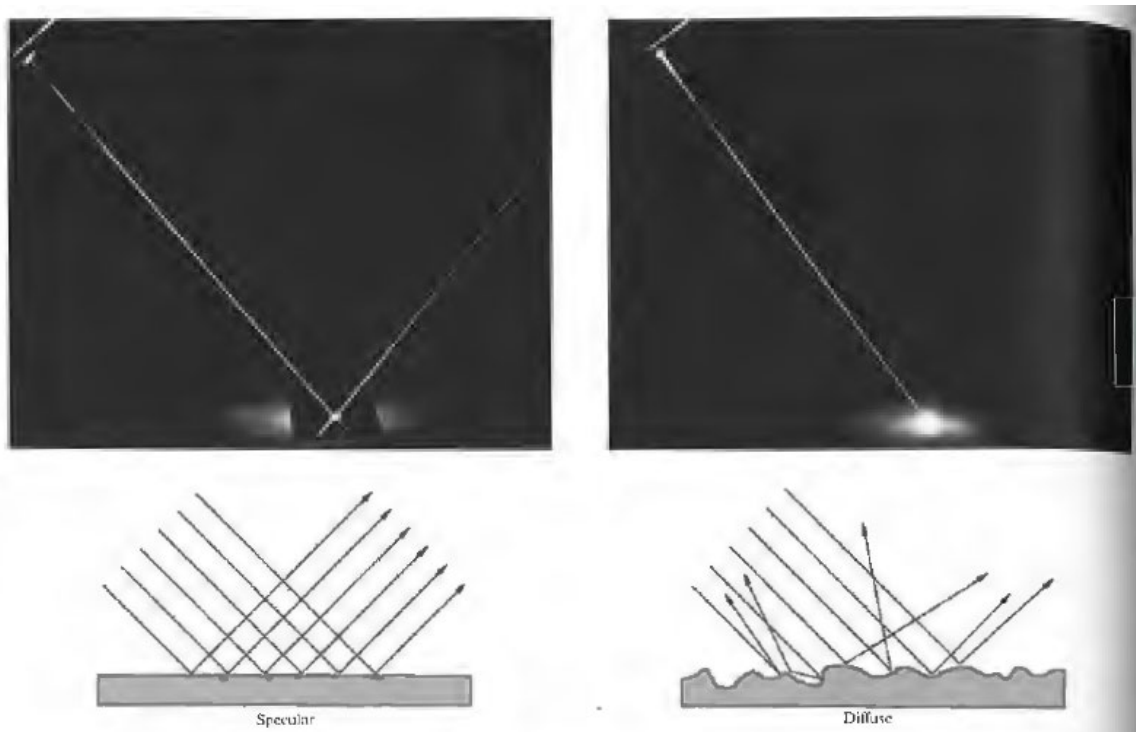
The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner. Exhibit 1061,<sup>8</sup> Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:

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<sup>8</sup> Eugene Hecht, *Optics* (2nd ed. 1990).

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This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1061, 87–88 (original page numbers). The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*; *see also* Ex. 1060 ¶ 46 (“A [person of ordinary skill in the art] would have understood that light which backscatters from the measurement site after diffusing through tissue reaches the active detection area provided from various random directions and angles.”).

Dr. Kenny testifies that Aizawa “detect[s] light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.’” Ex. 1060 ¶ 46 (quoting

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Ex. 1063, 86). Dr. Kenny further opines that a convex cover, when added to Aizawa's sensor with multiple detectors symmetrically arranged about a central light source, allows light rays that otherwise would have missed the detection area to instead be directed toward that area as they pass through the interface provided by the cover, thus increasing the light-gathering ability of Aizawa's sensor. *Id.* ¶¶ 47–49.

By contrast Dr. Madisetti testifies that “a convex cover condenses light passing through it towards the center of the sensor and away from the periphery.” Ex. 2004 ¶ 87; *see also id.* ¶¶ 82, 86. We have considered this testimony, however, Dr. Madisetti's opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* ¶ 89. Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 87–90. In other words, even if Patent Owner is correct that the '366 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light reflected by a user's tissue is scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that “Petitioner and Dr. Kenny both admit that a convex cover condenses light towards the center of the sensor and away from the periphery,” in a different petition filed against a related patent, i.e., in IPR2020-01520. PO Resp. 46–47; Ex. 2004 ¶¶ 87–88. The cited portions of the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the “mean path length” of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is



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inconsistent with Dr. Kenny’s testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Aizawa’s symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. *See, e.g.,* Ex. 1060 ¶¶ 49, 55 (“Ohsaki’s convex cover provides a slight refracting effect, such that light rays that may have otherwise missed the detection area are instead directed toward that area”). We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface.

We additionally do not agree with Patent Owner’s argument that Petitioner’s Reply presents new arguments and evidence that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. *See* Sur-reply 16–19. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa’s device. *See* Pet. 26–29. The Patent Owner Response then challenged that contention, with several arguments that Petitioner’s proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See* PO Resp. 45–53. This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019) (“Consolidated Guide”),<sup>9</sup> 73 (“A party also may submit rebuttal

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<sup>9</sup> Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

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evidence in support of its reply.”). This is what Petitioner did here. The Reply does not change Petitioner’s theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 26–29, *with* Pet. Reply 20–30.

### Rationale 3

Petitioner further contends that a person of ordinary skill in the art would have recognized that a cover with a protruding convex surface, such as that taught by Ohsaki, would “protect the elements within the sensor housing” of Aizawa. Pet. 28. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would also protect the sensor’s internal components in a manner similar to Aizawa’s flat acrylic plate. Ex. 1003 ¶ 79; *see also* Ex. 1008 ¶ 15 (noting that a cover “protect[s] the LED or PD”).

We disagree with Patent Owner’s fourth argument that a person of ordinary skill in the art would not have modified Aizawa as proposed because a convex cover would be prone to scratches and because other alternatives existed. Patent Owner does not explain how the potential presence of scratches on a convex cover would preclude that cover’s ability to, nonetheless, protect the internal sensor components in Aizawa, as Petitioner proposes. That a convex cover may be more prone to scratches than Aizawa’s flat cover is one of numerous tradeoffs that a person of ordinary skill in the art would consider in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). The totality of the final record does not support that the

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possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

*viii. Summary*

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

*6. Dependent Claims 2–12*

Petitioner also contends that claims 2–12 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 54–75. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 116–148.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 66 (“[T]he Petition fails to establish that independent claims 1, 14, and 27 are obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims.”).

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the

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evidence that claims 2–12 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–12 would have been obvious over the cited combination of references.

### 7. Claims 14–27

Independent claim 14 includes limitations substantially similar to limitations [a], [c]–[h], [j], and [k] and includes additional limitations drawn to “one or more processors configured to: receive information . . . ; [and], process the information to determine physiological parameter measurement information.” *Compare* Ex. 1001, 44:57–45:27, *with id.* at 46:33–56. In asserting that claim 14 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith, Petitioner refers to the contentions made regarding claim 1. *See* Pet. 75–76; Ex. 1003 ¶¶ 149–157.

Dependent claims 15–26 all depend directly or indirectly from independent claim 14. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 76–81. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 158–181.

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Independent Claim 27 contains numerous limitations, which are integrated from claim 1 (limitations [a]–[k]) as well as limitations from numerous dependent claims. *Id.* at 48:1–49:10 (reciting also a “touch-screen” and certain “preprocessing electronics”). In asserting that claim 27 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, and Goldsmith, Petitioner refers to the contentions made regarding claim 1, as well as claims depending therefrom. Pet. 81–84; Ex. 1003 ¶¶ 183–210.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 66 (“[T]he Petition fails to establish that independent claims 1, 14, and 27 are obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims.”).

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 14–27 would have been obvious over the cited combination of references and as supported by the testimony of Dr. Kenny. *See supra* II.D.5; Ex. 1003 ¶¶ 149–210.

*E. Obviousness over the Combined Teachings of  
Aizawa, Mendelson-2003, Ohsaki, Goldsmith, and Sherman*

Petitioner contends that claim 13 of the ’366 patent would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, Goldsmith, and Sherman. Pet. 84–88; *see also* Pet. Reply 37–38. Patent Owner disagrees. PO Resp. 66–67; *see also* Sur-reply 29.

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Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claim 13 is unpatentable.

### *1. Overview of Sherman (Ex. 1047)*

Sherman is a patent titled "Magnetic Clasp for Wristwatch Strap," and it relates to use of magnetizable material embedded in thermoplastic material with rows of alternating magnetic poles. Ex. 1047, codes (54), (57). Sherman discloses a magnetic fastening mechanism for "wrist instruments," such as wristwatches. *Id.* at 1:4–10. Sherman's system provides "an improved clasp for a flexible strap which eliminates buckles or other types of protruding members" and is "secured, yet easy to engage when desired." *Id.* at 2:1–11. As shown below in Figure 2 of Sherman, the mechanism includes a pair of flexible strap ends having "permanently magnetizable material" of opposite polarities in addition to "mutually nesting uniformly spaced protuberances and indentations." *Id.* at 2:43–62, Fig. 2.

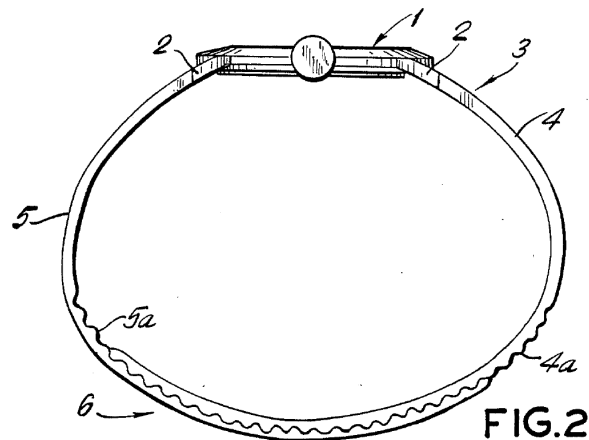


Figure 2 of Sherman depicts an end elevational view showing the wristwatch and strap with transverse ridges 4a and 5a incorporating magnetic securing materials. *Id.*

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## 2. *Dependent Claim 13*

Claim 13 additionally requires “a magnet configured to be used as a connecting mechanism.” Ex. 1001, 46:31–32. Petitioner contends that it would have been obvious for a person of ordinary skill in the art to have modified the sensor system of Aizawa-Ohsaki-Goldsmith to integrate a magnetic connection as taught by Sherman. Pet. 84–88.

### Petitioner’s Contentions

Petitioner contends that although Goldsmith generally discloses a fastener, Goldsmith “provides no details describing the fastener,” but that a person of ordinary skill in the art “would have been motivated to look to other wearable, wrist worn devices such as Sherman’s, for details regarding a mechanism for fastening a monitoring device.” Pet. 86 (citing Ex. 1003 ¶¶ 211–214). Petitioner contends a person of ordinary skill in the art would have been motivated to add Sherman’s magnetic connection in order to be more visually appealing, prevent corners from catching upon clothing, and to prevent broken connectors or accidental snagging. *Id.* (citing Ex. 1047, 1:11–24; Ex. 1003 ¶ 212).

### Patent Owner’s Contentions

Patent Owner disputes Petitioner’s contentions. Patent Owner argues that Petitioner’s proposed combination relies on Sherman solely for its alleged disclosure of a magnetic connector, but Ohsaki already includes a series of dedicated belts designed to exert a specific pressure on the user’s wrist. PO Resp. 67 (citing Ex. 1014 ¶18). Patent Owner alleges that a person of ordinary skill in the art would have understood that any advantage from Ohsaki’s convex board would also require Ohsaki’s specific

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attachment arrangement, which includes belts and a cushion to prevent movement, yet, Petitioner does not explain how Sherman would have allowed consistent attachment pressure for its sensor as required by Ohsaki. *Id.* (citing Ex. 1014 ¶ 18); *see also* Sur-reply 29 (“Ohsaki teaches a specialized attachment mechanism having specific features to “stably fix[]” the detecting element to the wrist and improve signal-to-noise.”). Thus, Patent Owner contends that the person of ordinary skill in the art would not have been motivated to incorporate Sherman’s magnetic attachment mechanism into Petitioner’s proposed combination. *Id.* (citing Ex. 2004 ¶ 122); *see also* Sur-reply 29.

#### Analysis

We are persuaded by Petitioner’s evidence and argument that a person of ordinary skill in the art would have been motivated to combine Sherman’s teaching of a magnetic connection in the existing combination of references. We find persuasive Dr. Kenny’s testimony that a person of ordinary skill in the art would have understood from Ohsaki itself that a particular strap is not required to obtain the benefits of Ohsaki’s convex cover. Ex. 1060 ¶ 72 (noting that “nothing in Ohsaki links the benefits of its convex cover to the use of any particular type of strap.”). Further, we are persuaded by Dr. Kenny’s testimony that “[t]he combination involves nothing more than applying a known technique to fasten two ends of a strap for attaching a wrist worn device to a user’s arm.” Ex. 1003 ¶ 214. In light of the totality of the record, including Dr. Kenny’s testimony, we determine that a person of ordinary skill in the art would have been motivated to employ Sherman’s magnetic connector because the pressure range required for Ohsaki’s



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benefits could be achieved by any number of connection fastening mechanisms.

Further, Patent Owner's arguments do not persuasively address Petitioner's proposed combination. *See* Pet. 25–29, 86–88. Ohsaki was relied upon for its teaching that a convex surface protruding into a user's skin will, *inter alia*, prevent slippage. *See id.*; *see also* Ex. 1060 ¶ 11; Ex. 1014, 25, Figs. 4A, 4B. As discussed above, we found persuasive Dr. Kenny's testimony that a person of ordinary skill in the art would have had reason, in view of that teaching, to modify the Aizawa's sensor's flat cover to include a protrusion, so as to improve adhesion between the user's wrist and the sensor's surface, improve detection efficiency, and protect the elements within the sensor housing. *See* Ex. 1003 ¶¶ 76–80. The resulting sensor features Aizawa's cover modified in view of Ohsaki, not Ohsaki's translucent board. Ex. 1060 ¶ 7. Likewise, Patent Owner does not effectively rebut Dr. Kenny's testimony that a person of ordinary skill in the art would have integrated a magnetic connector in the combination of references in view of Sherman for reasons related to engagement and user comfort. *See* PO Resp. 66–67; Ex. 1003 ¶¶ 213–214 (“because it provided details of a wrist-worn device fastening mechanism that addresses the above-noted problems, is easy to engage, and improves user comfort”); Ex. 1060 ¶ 72.

### 3. Conclusion

We have considered the evidence and arguments of record, including those directed to claim 1 and addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claim

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13 would have been obvious over the combined teachings of Aizawa, Mendelson-2003, Ohsaki, Goldsmith, and Sherman for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Pet. 84–88; Ex. 1047, 1:11–25, Fig. 2; Ex. 1003 ¶¶ 211–216.

### III. CONCLUSION

In summary:<sup>10</sup>

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–12, 14–27	103	Aizawa, Mendelson- 2003, Ohsaki, Goldsmith	1–12, 14–27	
13	103	Aizawa, Mendelson- 2003, Ohsaki, Goldsmith, Sherman	13	
<b>Overall Outcome</b>			1–27	

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<sup>10</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

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#### IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–27 of the '366 patent have been shown to be unpatentable; and,

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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